VOLUME 37 NUMBER 1 JANUARY, 1954

# AMERICAN JOURNAL
## OF
# OPHTHALMOLOGY

THIRD SERIES FOUNDED BY EDWARD JACKSON

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DEPARTMENTS



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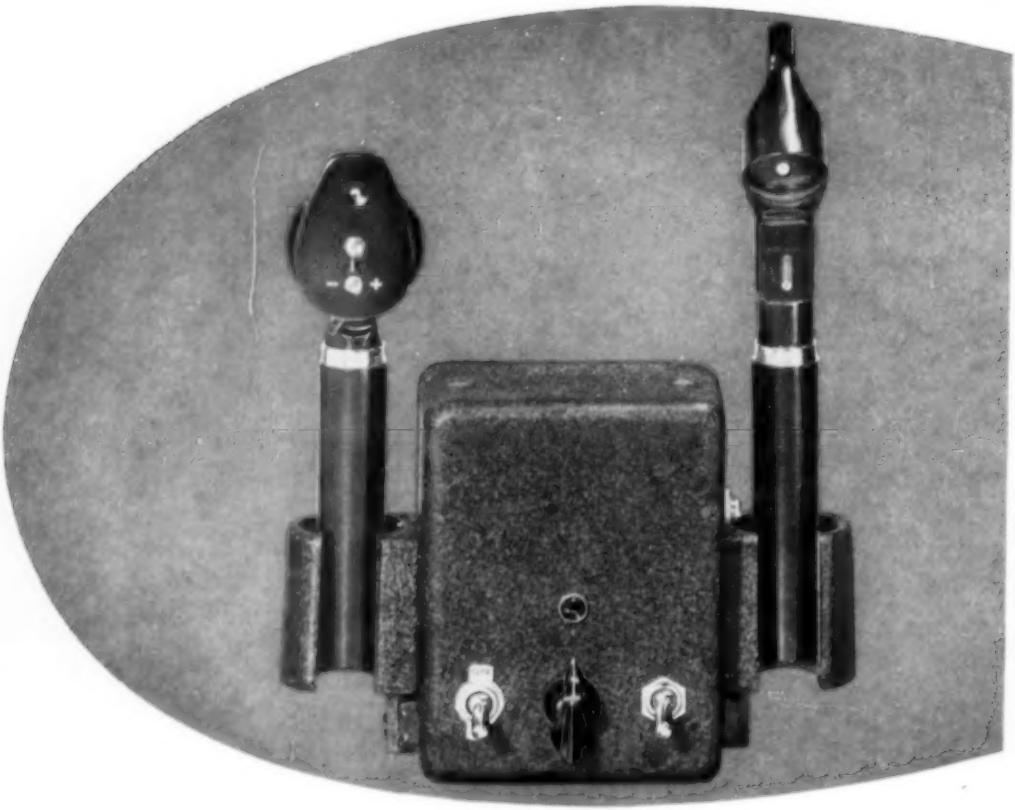
# A unique new transformer— the Jenkel-Davidson *TRANS-PORT*



**$40.00**
*without instruments*

**THIS** convenient, adjustable transformer for use in your office, has outlets for two diagnostic instruments. These outlets are controlled independently, with resistance variable from 0 to 6 volts. Handy indicator light provides constant reminder.

The Jenkel-Davidson Trans-Port is excellently designed and is made from the finest quality materials so you can use it for years.

When ordering, please specify the diameter of your instrument handles and the lamp voltage.

*Jenkel-Davidson*
OPTICAL COMPANY

366 POST STREET • SAN FRANCISCO, CALIFORNIA

*curb inflammation*

*combat infection*

*protect the injured eye*

# CORTOMYD

## *Ophthalmic Suspension Sterile*

*CORTOGEN (cortisone acetate) and SODIUM SULAMYD (sodium sulfacetamide)*

## *acts rapidly, safe, well tolerated*

CORTOMYD* Ophthalmic Suspension *(sterile)*, containing 1.5% (15 mg. per cc.) cortisone acetate (CORTOGEN® Acetate) with 10% (100 mg. per cc.) sodium sulfacetamide (Sodium SULAMYD®), 5 cc. dropper bottle.

*T.M.

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Upjohn

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# for inflammation,
# neomycin
# for infection:

# Neo-Cortef *Acetate Ointment*

TRADEMARK FOR THE UPJOHN BRAND OF HYDROCORTISONE (COMPOUND F) WITH NEOMYCIN SULFATE

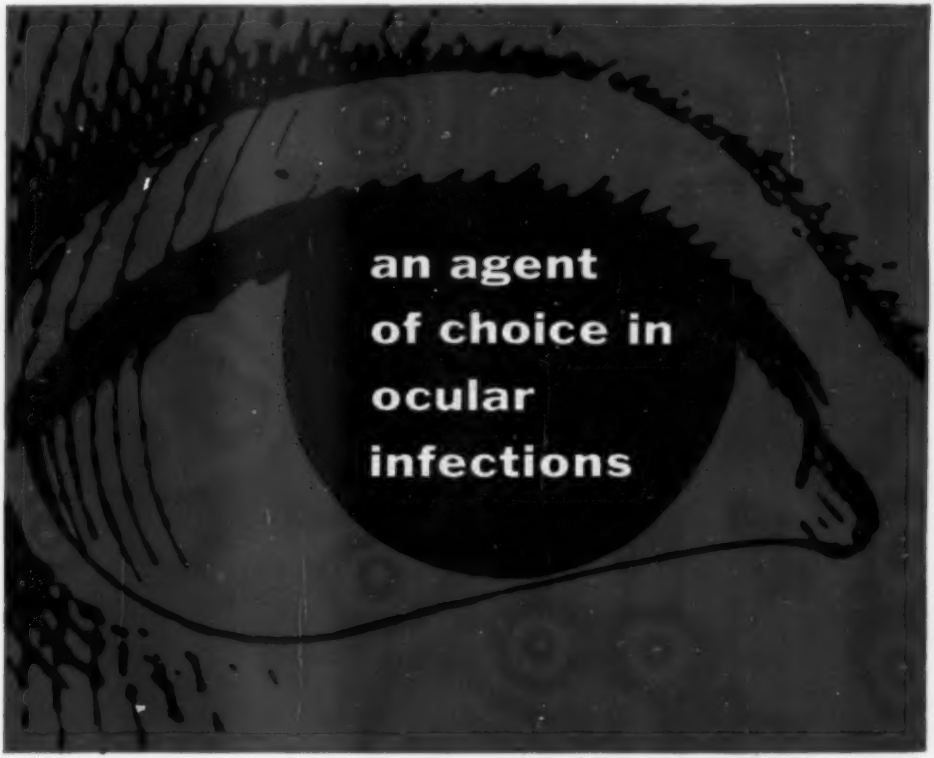
Available in 5 Gm. and 20 Gm. tubes

*Each gram contains:*

Hydrocortisone acetate . . . . 10 mg. (1%) or 25 mg. (2½%)
Neomycin sulfate . . . . . 5 mg.
(equivalent to 3.5 mg. neomycin base)
Methylparaben . . . . . 0.2 mg.
Butyl-p-hydroxybenzoate . . . 1.8 mg.

*TRADEMARK FOR THE UPJOHN BRAND OF HYDROCORTISONE (COMPOUND F)

THE UPJOHN COMPANY, KALAMAZOO, MICHIGAN

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The wide range of causative organisms sensitive to well-tolerated Terramycin makes this promptly effective, broad-spectrum antibiotic an agent of choice in the treatment of many common ocular infections including conjunctivitis, blepharitis, trachoma, scleritis, keratitis, iritis, dacryocystitis, corneal ulcers. Terramycin is supplied in convenient preparations for topical use alone or in conjunction with systemic therapy.

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with Polymyxin B Sulfate—10 mg. of Terramycin plus 10,000 units (1 mg.) polymyxin B sulfate per Gm. ointment in ⅛ oz. tubes.

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25 mg. Terramycin in 5 cc. dropper vials.

Pfizer

**PFIZER LABORATORIES,** *Brooklyn 6, N. Y.*
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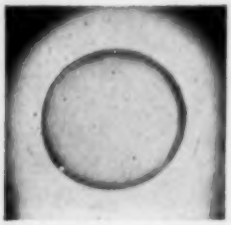
# sphere implants



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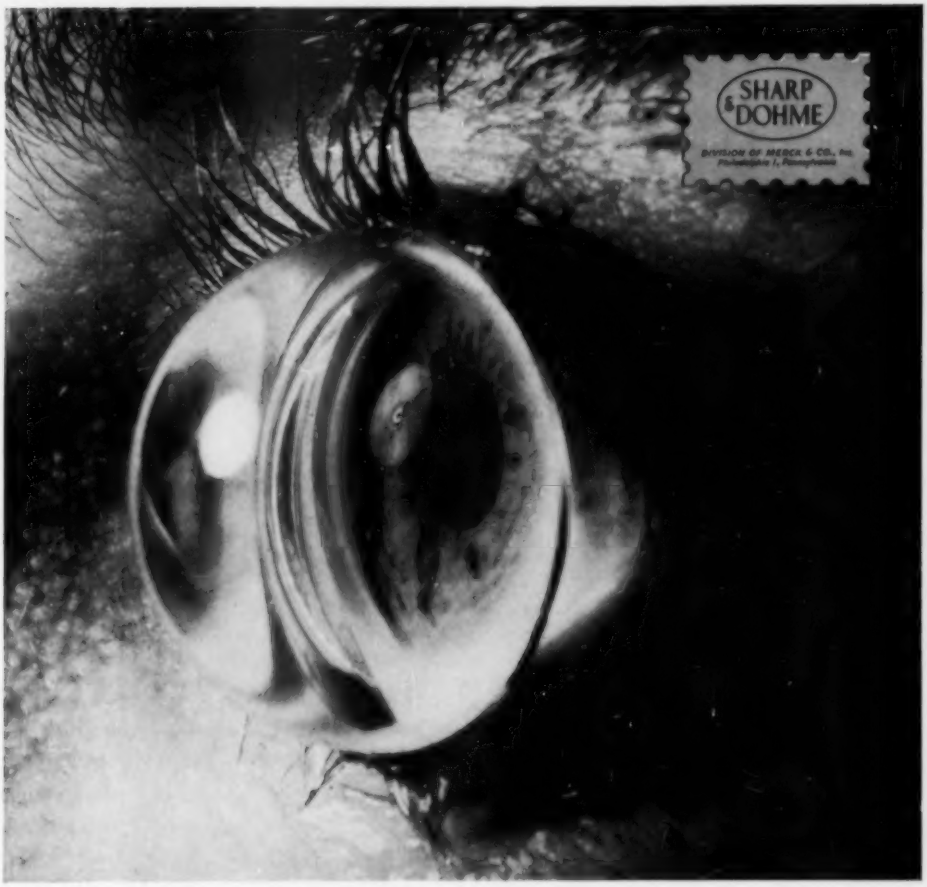


Gonioscopic lens over cornea may be used to distinguish between wide- and narrow-angle glaucoma.

*Potent aid in wide-angle glaucoma*

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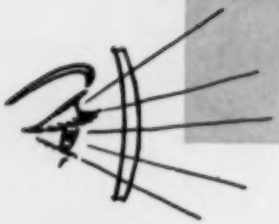
**SUPPLIED:** As a 0.1 per cent solution in peanut oil, 5-cc. vials.

# Orthogon Lenses are made the way they are because eyes work the way they do



*The image formed by any off-center portion of a lens is degraded by the amount of astigmatic error introduced.* This aberration, known as marginal or oblique astigmatism, is one for which the eye can make no compensation or accommodation. And this is the aberration for which the Orthogon series is specifically corrected. Before you prescribe any "corrected" lens, be sure you know *what* it's corrected for. Bausch & Lomb Orthogon is corrected to eliminate the effect of marginal astigmatism—it makes possible clear center-to-edge vision.

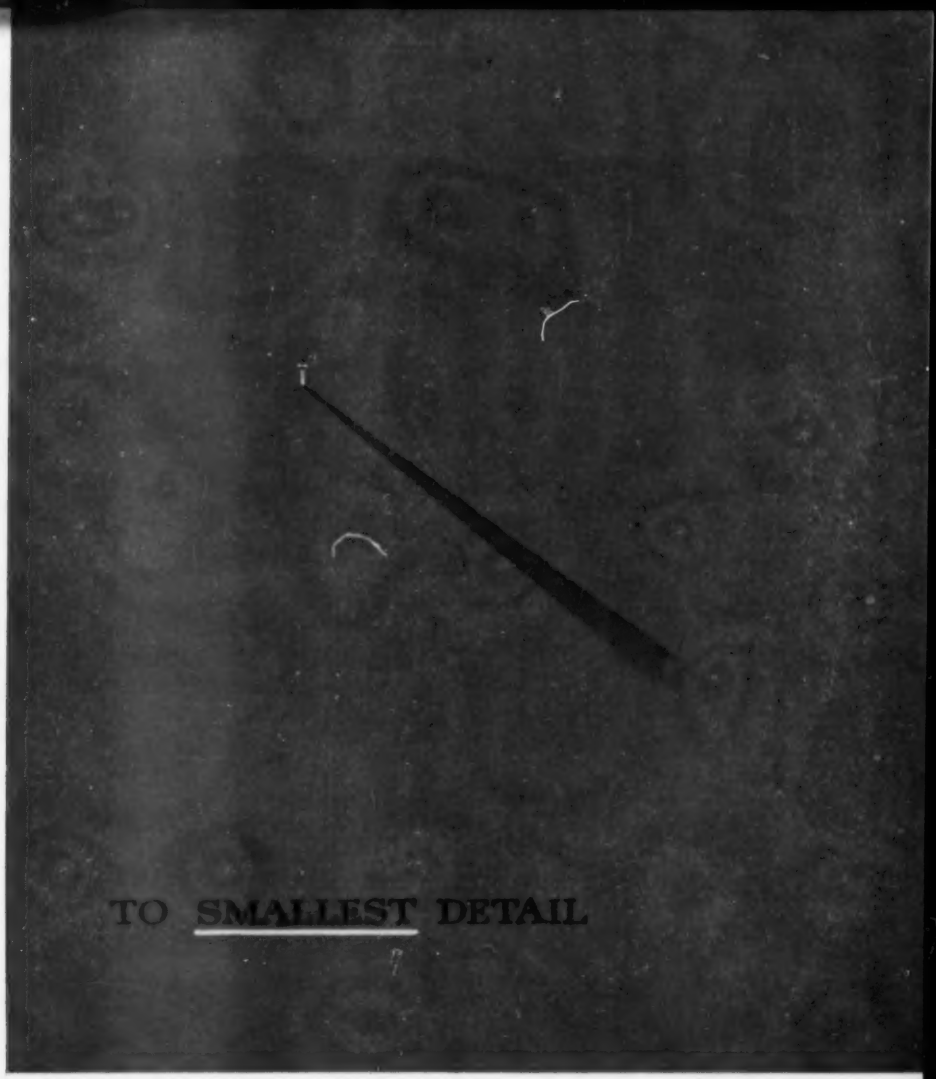
*In Soft-Lite, too*

*The Orthogon system of lens correction is based on the principle that only through reduction of astigmatic variation ... to a level below the physiological limits of human perception ... can utmost clarity of vision be achieved.*

BAUSCH & LOMB Orthogon LENSES

AVAILABLE IN THE WIDEST RANGE OF SINGLE-VISION,

ABSORPTIVE AND MULTI-FOCAL TYPES




Care and accuracy, the Shuron watchwords, tied to the personal pride each worker takes in turning out a perfect product (whether frames, lenses, cases or machinery) — treating each unit as if it were custom made is the reason why Shuron products have consistently been the leaders in quality. Coupled with the smartest in fashion styling, Shuron products spell complete patient confidence while building professional reputation for you.

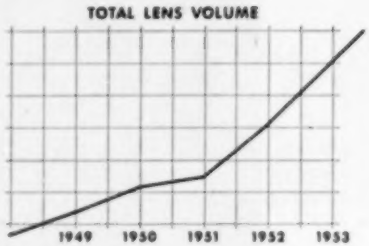
demand SHURON ...don't settle for less than the "Best"

SHURON OPTICAL COMPANY, INC. • GENEVA, N. Y.

# *Univis' year end report*

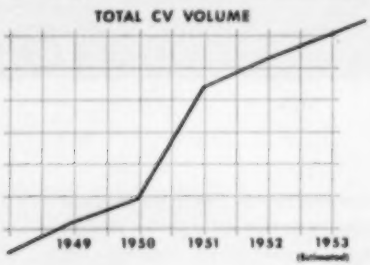
## *To its customers*

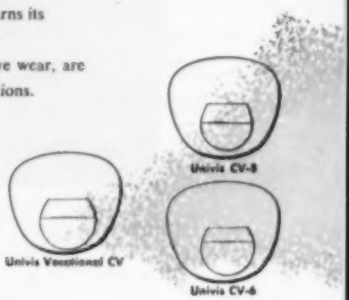
The year 1953, in which Univis completed 27 years of service to the industry and profession, was marked by many achievements. These achievements, we believe, should be reported to you for two reasons: (1) They come at a time when profitable developments in the industry and profession are of maximum importance and; (2) It is your support that has made this progress possible.




## *Univis usage*

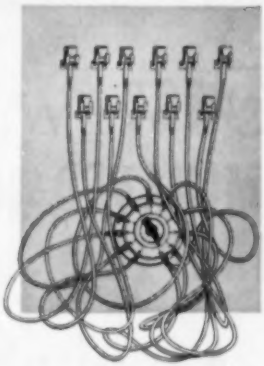
The company's production in 1953, its sales, its volume, its shipments, all were greater than any previous year in its history. This marks the fifth consecutive year that your usage of CVs and total Univis products has exceeded that of the previous year. This is a noteworthy fact in view of the many imitations of the Univis straight top design, which have appeared in the last several years. Though there are many factors contributing to this steady rise in Univis usage, probably the most important is an intangible called reputation. Never shown in an organization's financial statement, this quality is priceless. Such a company (and one is found in every field of endeavor) earns its reputation by setting the standard for the industry with the finest product available. The profession and industry, dedicated to the best in eye care and eye wear, are turning more and more to Univis for exact interpretation of multifocal prescriptions.




## *Professional and industrial organizations*

Because of its great faith in the service rendered by the ophthalmic profession, Univis, in 1953, continued its support of outstanding professional and industrial organizations who are making substantial contributions to ophthalmic progress. Also by contributions and grants in aid, Univis made possible many research projects in schools and universities throughout the country. We believe this is the type of program you wish us to support. Our contribution to them is, in effect, a contribution for you.

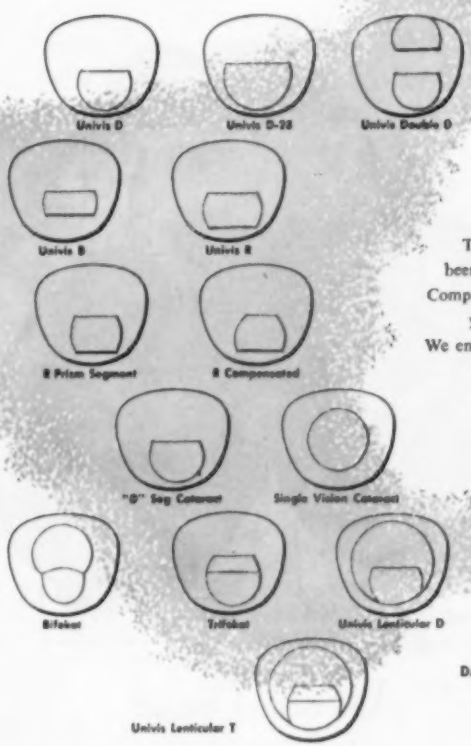


## *Production accuracy*

By means of new and unique production control methods and instrumentation, Univis was able, in 1953, to narrow its production line tolerances to 25 millionths of an inch. This is probably the most accurate work done on *a production line* basis in this or any other industry. Such a tiny dimension is roughly 1/200ths the thickness of this sheet of paper. To you this means absolute accuracy in those four features of a multifocal lens important to you.

## *A complete service*

A complete product line is one which offers you immediate stock availability—what you need—when you need it—where you need it. In 1953, Univis carried as standard stock, available to you for immediate delivery, a total of 9500 stock items.




## *Research and development*

In 1953, Univis applied for 24 patents. Some have been granted; the others are pending. The Product Research and Development Division achieved many major successes as new products left drawing board and pilot plant, and moved out to the production line. These completed and nearly completed projects give promise of major technological advances for you, for the profession and the industry. They also promise products of great appeal; products which will open new opportunities for advancement and prestige.

## *Outlook*

This is what has happened at Univis during 1953. It has only been made possible by you, our customers. The Univis Lens Company would like to express its gratitude and appreciation for your continued cooperation and loyalty through 1953. We enter the new year with every reason to believe the future, yours and ours, is bright and assured.

UNIVIS

THE UNIVIS LENS COMPANY

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# AO 590 ILLUMINATED PHOROPTOR

*Has NO Rivals*

FOR patient comfort, Rx accuracy, and elimination of waste motion — no other ophthalmic instrument can compare with the AO 590 Additive Phoroptor. For it is the complete *refraction* instrument combining —

**ADDITIVE EFFECTIVE POWER**
Lens System, self-contained, compensates for curvature, thickness, and distances between test lenses.

**3 POINT CORNEAL ALIGNMENT**
(AO patent) for precise positioning of cornea in relation to the lens system — necessary for true effective power.

**HIGH INTEGRAL LENS RANGE**
from −19.12D to +16.87D in spheres, and from 0 to 6.00 + or − in cylinders (to 8.00D with accessories).

**15Δ ROTARY PRISM LOUPES**
— double the accuracy in phoria measurements. Built-in auxiliary disc adds 15Δ base-out and 10Δ base-in for each eye, also 6Δ (base down in left dial, base up in right).

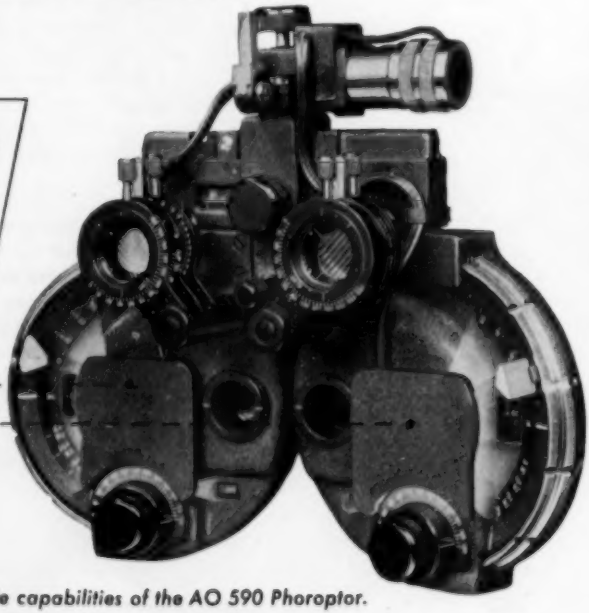
**CONICAL INSTRUMENT HOUSING**
curving away from patient's face, holding test lenses always at right angles to line of sight. Unusual facial contours do not prevent close fitting and accurate refraction.

**FLARED APERTURES**
— large in front, normal in back — eliminate tubular vision. Allow retinoscopy at greater angles.

**EASILY CLEANED**
all lenses may be reached from outside the instrument with cleaning pencil.

***...And NEW optional ATTACHED ILLUMINATOR***

**Fits inconspicuously against each housing. For easy reading of cylinder axis, sphere power, cylinder power, and auxiliary dial scale, even in a darkened refracting room.**



***Prove to yourself the remarkable capabilities of the AO 590 Phoroptor. Ask your AO Representative for a demonstration.***

American Optical

INSTRUMENT DIVISION
BUFFALO 15, NEW YORK

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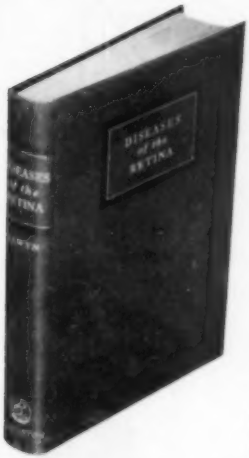

# Diseases of the Retina

By HERMAN ELWYN, M.D.
*Senior Assistant Surgeon*
*New York Eye and Ear Infirmary*

REVISIONS in this NEW edition are extremely thorough, bringing the book right up-to-date with recent advances in the field.

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- There are 73 NEW black and white illustrations and one color plate.
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- Three chapters have been *completely rewritten*, thus making this NEW 2nd edition an indispensable diagnostic guide for every general practitioner and specialist.

713 Pages; 243 Illustrations (20 in color) ..... $12.00

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THE PANTOSCOPE

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*Please write, phone or call for further details and literature.*

*drop for drop...*

*and minim for minim...*

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STERILE OPHTHALMIC SOLUTIONS

*assure the utmost in:*

- **CLINICAL EFFECTIVENESS**
- **PATIENT PROTECTION**

*Scientifically prepared,*
ISO-SOL ophthalmic solutions are:

- physiologically active
- exceptionally well tolerated
- buffered for stability
- sterile and bacteriostatic

*and* available in a variety of preparations routinely employed in ophthalmologic practice.

**Specify ISO-SOL— each dropper bottle is sterile, sealed and dated.**

*Now Available...*

| |
|---|
| *new* Mercury Oxycyanide with Zinc Sulfate in 15 cc. sterile, sealed dropper bottles. |
| Pilocarpine HCl. ½, 1, 2, and 4% in 15 cc. sterile, sealed dropper bottles. |
| Eserine Salicylate ⅛, ¼ and ½% in 7.5 cc. sterile, sealed dropper bottles. |
| Pilocarpine HCl. 2% plus Eserine Salicylate ¼% in 7.5 cc. sterile, sealed dropper bottles. |
| Pilocarpine HCl. 2% plus Eserine Salicylate ½% in 7.5 cc. sterile, sealed dropper bottles. |
| Note: ISO-SOL Eserine Salicylate solutions will not discolor. |

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STERILE BUFFERED
MIOTIC SOLUTIONS
for
GLAUCOMA THERAPY
in methyl cellulose
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"DROP-TAINER"
new ALCON plastic dropper container
PROVIDES more prolonged contact of medication with the eye — far better absorption.
Isopto®-Carpine 1% 15cc
contains 1% Pilocarpine HCl buffered to pH 6.4
Isopto®-Carpine 2% 15cc
contains 2% Pilocarpine HCl buffered to pH 6.4
Isopto®-Eserine ½% 15cc
contains ½% Eserine Salicylate buffered to pH 6.4
Prepared in a sterile, 5% Methyl Cellulose solution buffered to pH of maximum therapeutic effectiveness, and comfort for the patient.
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CHEMOTHERAPEUTIC
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Therapeutically effective in blepharitis ~ conjunctivitis
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Buffered to an acid pH for stability and comfort
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***Newly Developed Models***

**247e*** Forceps, Levator, BERKE $15.00
**249½*** Corneo-Scleral Forceps, KIRBY: light 14.50
**266b*** Forceps, Iris, CHANDLER 9.50
**273b*** Forceps, Iris, Gill Handle, delicate 10.50
**300 *** Forceps, Fixation, THORPE: for friable conjunctiva 13.75
**326b*** Forceps, Corneal and Splinter, THORPE 8.75
**327a*** Forceps, Suturing, CASTROVIEJO: teeth 0.9mm 10.50
**327b*** Forceps, Suturing, CASTROVIEJO: teeth 1.5mm 10.50
**335d*** Forceps, Suturing, LEAHEY: right angled teeth 13.50
**335e*** Forceps, Suturing, LEAHEY: forward angled teeth. 13.50
**389*** Forceps, Muscle, GUNDERSON 14.50
**390b*** Clamp, Muscle, BERENS 18.75
**405 *** Forceps, Marginal Chalazion, LEAHEY 13.75

* Stainless Steel

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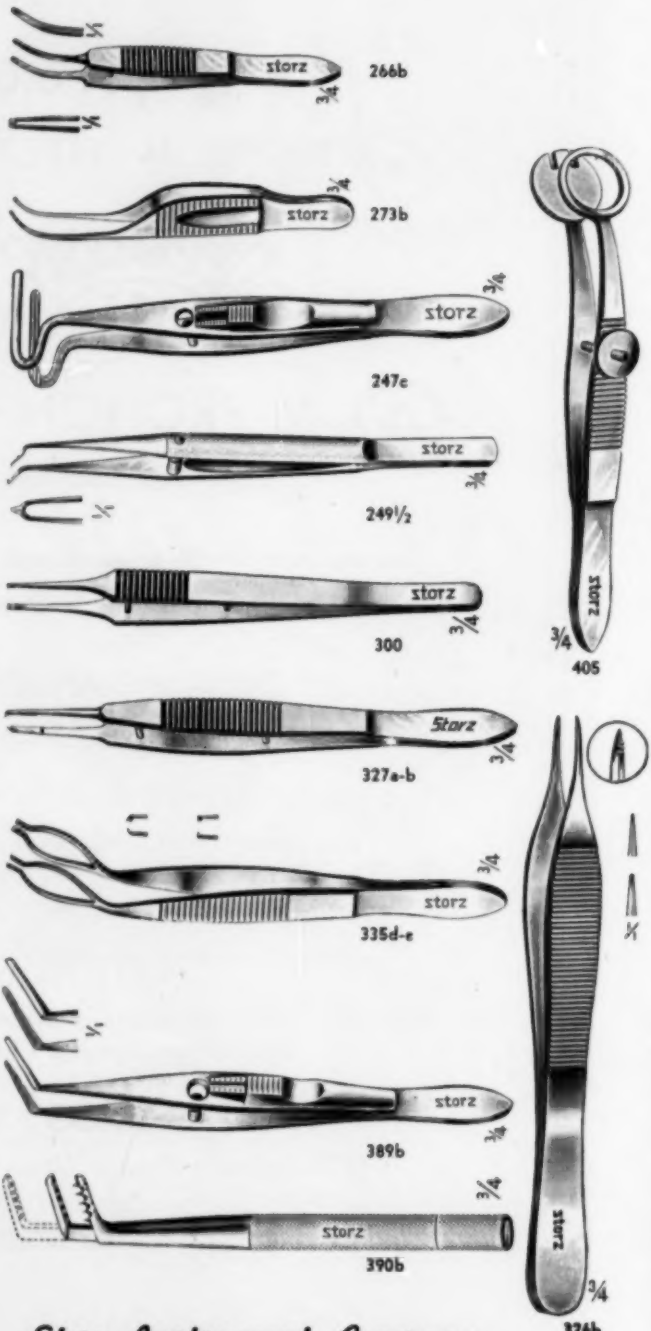
*Catalog sent upon request*

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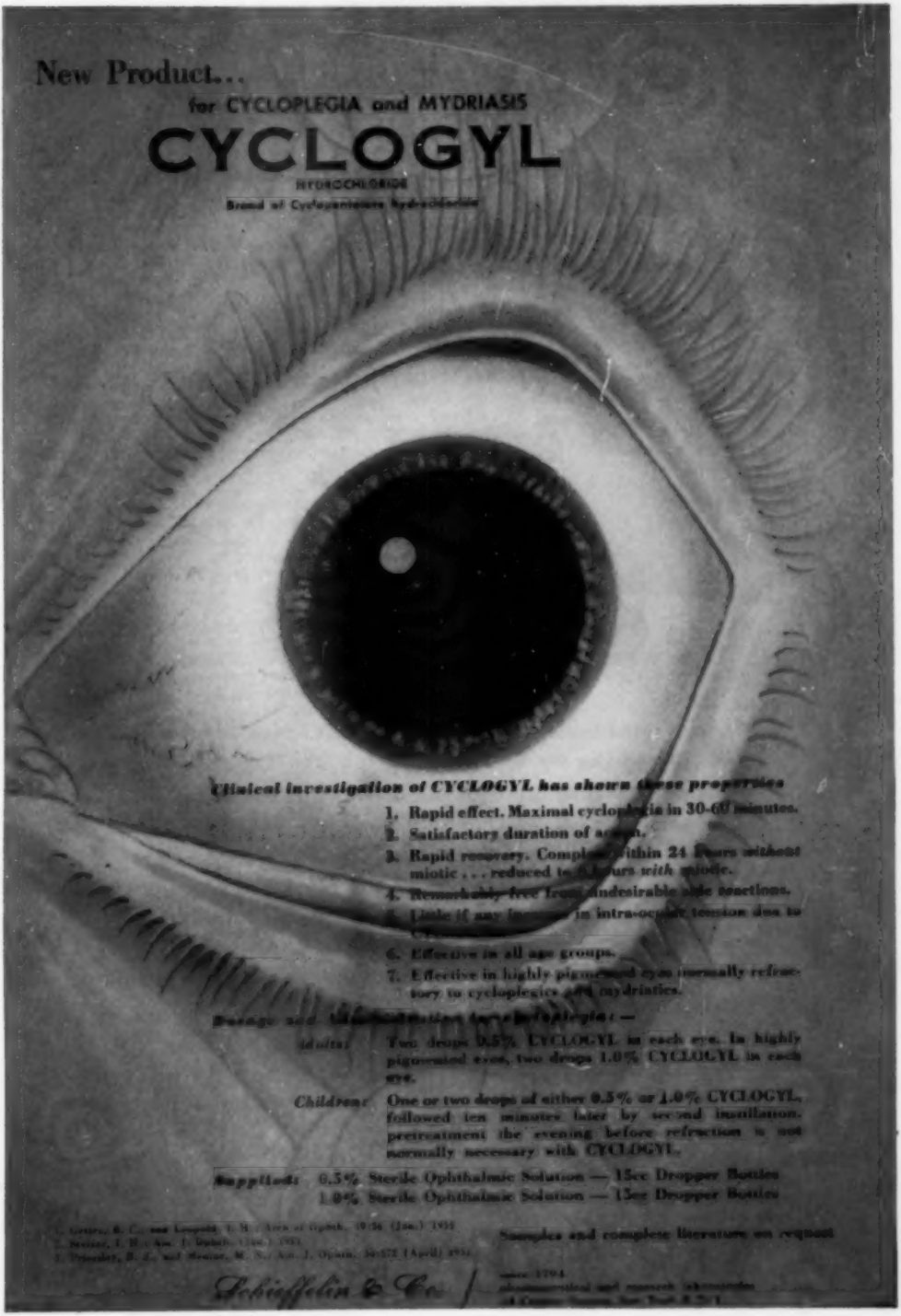
New Product...

for CYCLOPLEGIA and MYDRIASIS

CYCLOGYL

HYDROCHLORIDE

Brand of Cyclopentamine hydrochloride



*Clinical investigation of CYCLOGYL has shown these properties*

1. Rapid effect. Maximal cycloplegia in 30-60 minutes.
2. Satisfactory duration of action.
3. Rapid recovery. Complete within 24 hours without miotic . . . reduced to 6 hours *with* miotic.
4. Remarkably free from undesirable side reactions.
5. Little if any increase in intra-ocular tension due to CYCLOGYL.
6. Effective in all age groups.
7. Effective in highly pigmented eyes normally refractory to cycloplegics and mydriatics.

Dosage and administration in cycloplegia: —

*Adults:* Two drops 0.5% CYCLOGYL in each eye. In highly pigmented eyes, two drops 1.0% CYCLOGYL in each eye.

*Children:* One or two drops of either 0.5% or 1.0% CYCLOGYL, followed ten minutes later by second instillation. pretreatment the evening before refraction is not normally necessary with CYCLOGYL.

*Supplied:* 0.5% Sterile Ophthalmic Solution — 15cc Dropper Bottles
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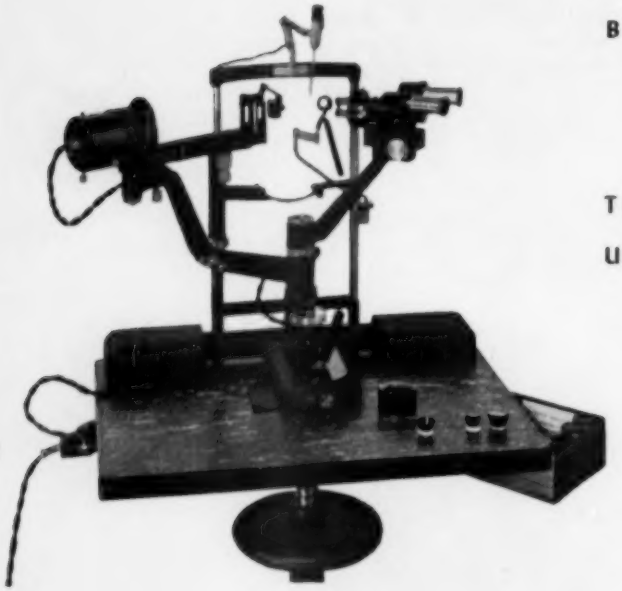

THE OPTICS ARE UNEXCELLED

A single control handle (joystick type) permits instant adjustment, either gross or minute, in any direction.

The elevation control is located near the "joystick" so that all adjustments are made with one hand, leaving the other hand free for working on patient's eye.

When the microscope is perfectly focused, the slit beam is also perfectly focused in the center of the field of observation. The optical section remains adjusted when changing plane or area of examination.

3 magnifications available (up to 40X). Brilliant illumination with very convenient slit adjustment—with a 2 volt overload available. (8 volt total).

Using accessories, it is possible to examine the fundus and get a true optical section and to do Slit lamp gonioscopy with patient seated at a normal Slit lamp installation.

**Standard Accessories:**
Goldmann Reduction Prism - Illuminated Fixation Device
Hruby-55 Diopter Lens for fundus examination
Contact glass for fundus examination
Contact glass for gonioscopy
Ulbrich Drum to measure depth and plane in the eye

**Extra Accessories:**
Measuring Eye Piece
Tyndallimeter—to measure corneal haze
Second Observer's Eye Piece complete with inside pointer for teaching and clinical use.

*The House of Vision Inc.*

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AMERICAN JOURNAL OF OPHTHALMOLOGY

SERIES 3 · VOLUME 37 · NUMBER 1 · JANUARY, 1954

# CONTENTS

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is the surface anesthetic that can compare with Pontocaine hydrochloride for dependability, durable effect and penetrating power.

For a great variety of therapeutic and surgical procedures on the pharynx, larynx, trachea, bronchi and the eye, you can rely upon prolonged and penetrating Pontocaine.

Effective in anesthetizing mucous membranes of the pharynx, larynx, trachea, bronchi and the eye.

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New York 18, N. Y. • Windsor, Ont.

WINTHROP

**Supplied**

for surface anesthesia *in ophthalmology . . .* as 0.5 per cent solution in bottles of ½ oz. and 2 oz., and 0.5 per cent ointment in ⅛ oz. tubes.
for surface anesthesia *in rhinology . . .* as 2 per cent solution in bottles of 1 oz. and 4 oz.

**For 5 hour nerve block and infiltration anesthesia**

surgical, diagnostic and therapeutic 0.15 per cent solution, vials of 100 cc.

Pontocaine (brand of tetracaine) trademark reg. U.S. & Canada

FIG. A

FIG. B

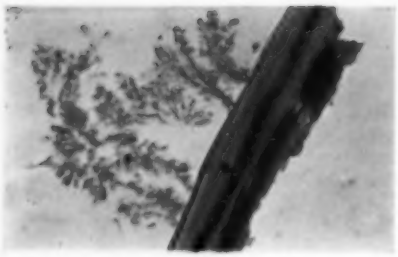

FIG. C

FIG. D

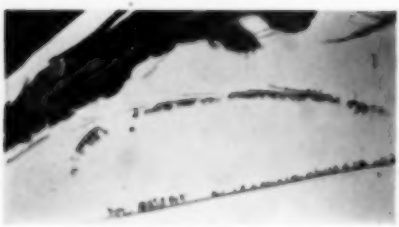

FIG. E

FIG. F

FIG. G

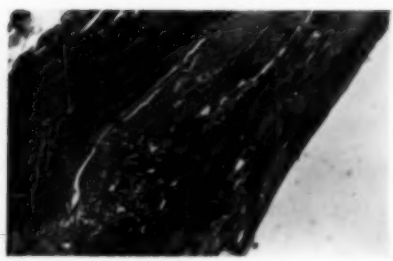

FIG. H

FIGS. A TO H (THEOBALD), PSEUDO-EXFOLIATION OF THE LENS CAPSULE.

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# PSEUDO-EXFOLIATION OF THE LENS CAPSULE*

## RELATION TO "TRUE" EXFOLIATION OF THE LENS CAPSULE AS REPORTED IN THE LITERATURE AND ROLE IN THE PRODUCTION OF GLAUCOMA CAPSULOCUTICULARE

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Although exfoliation of the lens capsule has been recognized as a pathologic condition for many years, it is apparent from the studies herein reported that there is another form of capsular change which, in its superficial pathologic characteristics, is so similar to true exfoliation of the lens capsule that it has repeatedly been mistaken for it, even by so great an authority as Vogt.

This second form of capsular change—which I propose to call pseudo- or false exfoliation of the lens capsule—is characterized by accretions of an unknown material on the lens capsule, ciliary body, and zonules. As yet the nature of this material is unknown but, since it is moderately positive with periodic acid and to the Schiff and Millon tests (made by Dr. George Gomori of the University of Chicago), it may be assumed that mucopolysaccharides and tyrosine are present.

Busacca has stated that exfoliation consists in the deposition of a granular substance which he assumes to be normally present in solution in the aqueous humor. Hoorgina thought it was due to the action of a chemically changed aqueous on the lens.

### PRESENT STUDY

It is the purpose of this paper to:

1. Report the histopathologic study of three eyes, removed in the Glaucoma Clinic of the Illinois Eye and Ear Infirmary, with the clinical diagnosis of "wide-angle glaucoma with exfoliation of the lens capsule," which revealed findings incompatible with the classic description of lens exfoliation.

2. Review briefly the literature on "true" exfoliation of the lens capsule.

3. Point out the similarities and differ-

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(Fig. a). Accretions on anterior lens surface, peeling off in form of a curl. Also deposits on posterior surface and pupillary margin of the iris. (Trichrome stain, ×25.)

(Fig. b). High-power view of accretions on lens surface. (Trichrome stain, ×430.)

(Fig. c). Midway between pupil and equator, deposits are feathery and branching. (Hematoxylin-eosin stain, ×430.)

(Fig. d). Soft, fluffy-appearing accretions near equator of lens. (Trichrome stain, ×430).

(Fig. e). Accretions deposited on posterior iris surface, on ciliary processes, and zonular fibers. (Trichrome stain, ×25.)

(Fig. f). Accretions deposited on ciliary body, zonular fibers, and anterior surface of vitreous. (Trichrome stain, ×100.)

(Fig. g). Accretions filling intratrabecular spaces, canal of Schlemm, and external collector channel. (Trichrome stain, ×100.)

(Fig. h). High-power view of Figure g. (Trichrome stain, ×430.)

ences in "true" and "false" exfoliation of the lens capsule.

4. Suggest that pseudo-exfoliation is related to glaucoma capsulocuticulare and that "true" exfoliation is related to certain forms (glass blowers') of cataract.

## Case reports

During routine histopathologic study of three eyes which were removed in the Glaucoma Clinic with the clinical diagnosis of "wide-angle glaucoma, with exfoliation of the lens capsule," I found that, although my findings coincided in part with those in earlier reports, these eyes revealed some pathologic findings which had not been recognized nor fully appreciated by previous authors.

### Case 1

A man, aged 60 years, first noted halos around lights with his right eye about three years ago. There had been no light perception in this eye for the last one and one-half years. It had been severely painful for the past eight months.

The tension was absolute. Examination showed "exfoliation" of the anterior lens capsule, but the cortex and nucleus remained clear. Flocculent debris was seen in the anterior chamber.

The chamber angle was wide, although blocked with deposits of fluffy white material. There was a wide, heavily pigmented trabecular ring. Tufts of flaky material were seen on the iris, both at the pupillary margin and over the surface. The iris appeared slightly atrophic. There was a deep glaucomatous excavation of the disc.

### Case 2

A man, aged 72 years, had had failing vision in the right eye for a number of years and had been blind for the past three years.

The tension was absolute. Bullous keratopathy and corneal edema prevented detailed examination of the anterior chamber. It was observed, however, that the angles of the anterior chamber were deep and that there was iridodonesis.

The left eye showed early "exfoliation" of the lens capsule in the pupillary area and flakes on the iris surface. The trabeculum and Schwalbe's line were heavily pigmented.

### Case 3

A man, aged 74 years, had been treated for glaucoma for the past two and one-half years. The left eye had had no light perception for the past two years.

One month ago, he developed pain in the left eye which could not be controlled by medication. The tension was absolute. "Exfoliation" of the lens capsule was noted, and fine white deposits were seen on the iris and in the angle. The lens was cataractous. The tension of the right eye was being controlled with miotics and fluctuated between 23 mm. Hg and 30 mm. Hg (Schiøtz).

## Discussion

Since the essential clinical findings in these three eyes are similar, they can be discussed together.

Clinically, each of these three patients had typical "capsular exfoliation" with accumulations in the anterior chamber, on the surface of the cornea and iris, and in the chamber angles. All three were known to have glaucoma for two to three years, which did not respond to treatment. Enucleation was done because the eyes were blind and painful.

## Pathologic study

The pathologic picture of the tissues was similar in the three eyes and differed only in degree. It was a degenerative process which gave no evidence of previous inflammation.

In evaluating the findings, the pathology of the aging process, as well as the pathology of the abnormal material and resulting glaucoma, had to be considered. The angles of the anterior chambers were wide, the discs cupped, and the retinas atrophic.

The eyes were sectioned serially and

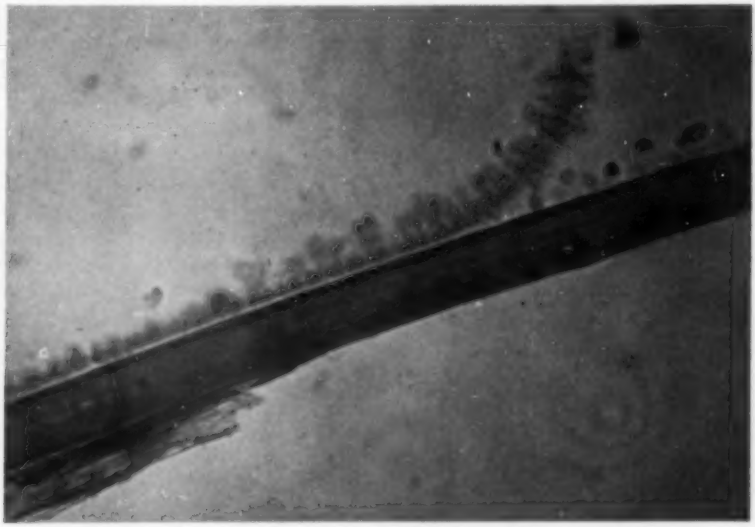

Fig. 1 (Theobald). Accretions on the anterior lens capsule, separated from the capsule by a clear, unstaining line (×430).

stained with hematoxylin-eosin and with the trichrome stain. With the latter stain, the accretions of precipitous deposits were more readily demonstrated than with the former. The trichrome stain showed the lens capsule to be thick, many layered, sclerosed, and hyalinized. Especially hyalinized was the pericapsular membrane.

The serial sections revealed that the accretions had formed on the anterior surface of the capsule as far back as the equator. They were, however, *separated* from the lens capsule by a clear, unstaining line (fig. 1) which has not, as yet, been identified.

The appearance of the accretions differed with the site of occurrence. In some sections, the distribution was spotty, as noted clinically by Vogt and others, but, in many other sections, the entire anterior capsular surface seemed to be involved.

In the pupillary area and just peripheral to it, the accretions were short and stubby (color plate, figs. a and b) and were arranged in tufts or irregular bundles standing side by side on the lens surface like shrubs in a hedge.

Evidently, they were composed of some sticky material for, where they were especially numerous, they clung together (color plate, figs. a and b) and crowded into the anterior chamber in the form of curls. Here and there the end of a curl doubled on itself to form a knob. Although the curls have been described clinically, I can find no histologic description of them. The curls appeared not only in the pupillary area but also some distance from it beneath the iris.

Midway between the pupillary border and the equator, the accretions were feathery and branched (color plate, fig. c) in appearance. Busacca and Sohby Bey descriptively used the term "myceliumlike" to designate the branching formations.

The pericapsular membrane beneath these branchlike accumulations stained less densely than in the pupillary area, thereby denoting a lesser degree of sclerosis and hyalinization. In the region of the zonular attachments near the equator, the pericapsular membrane stained faintly (color plate, fig. d) and the accretions appeared soft and fluffy. Both Vogt and Sohby Bey observed vacuoles in the lens capsule in some of their cases; how-

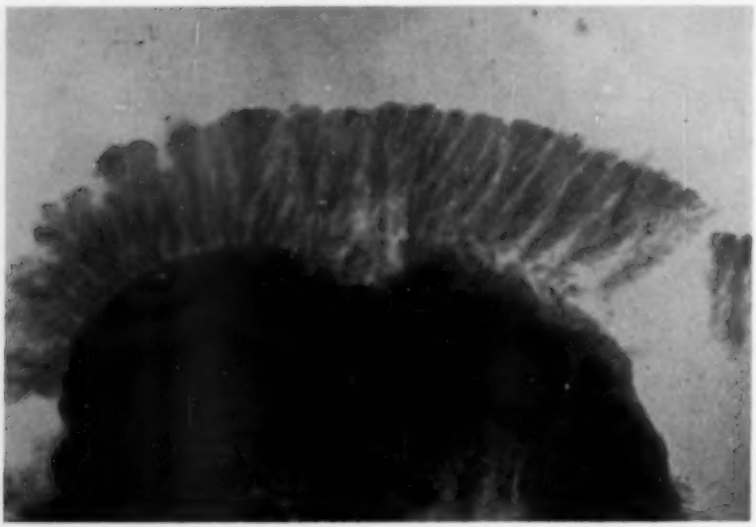

Fig. 2 (Theobald). Deposits or accretions cling to ciliary processes. (High-power view of Figure f in color plate, ×430.)

ever, none were found in these sections.

In the anterior segment of the eyeball, the accretions arranged themselves about the tissues in various ways. In the posterior chamber, they clung to the limiting membrane of the vitreous, the zonular (color plate, fig. e) fibers of the lens, the ciliary processes (figs. 2 and 3), and the posterior iris surface. They appeared as a homogeneous cover or layer, but mostly in the shape of feathery (color plate, fig. f), triangular wedges, stacked side by side and attached to the tissues in much the same way iron filings cling to a magnet (figs. 2 and 3).

The question has been raised as to whether the zonuoles exfoliate. The trichrome stain shows the zonules and the accretions to have different staining properties, which probably indicates that the red-staining zonules are simply providing a roosting place for the blue accretions and are not producing them.

The anterior chamber contained large amounts of fluffy material, the deposition of which was very interesting. Not only did the accretions lie loosely in the anterior chamber but they were absorbed by the endothelium lining it. Large globules and masses of the material, as well as migrated pigment, were phagocytized by the endothelium of the cornea and iris (fig. 4).

Busacca and Sohby Bey found massed formations of "exfoliated capsule" in the angle from the pectinate ligament to the iris. In the three eyes herein reported, the amorphous accretions not only covered the surface of the trabeculum (fig. 5) but filled the intratrabecular spaces (color plate, figs. g and h). In one eye, they filled the canal of Schlemm, apparently entering it by way of the inner canals of Sondermann. This also was best seen with the trichrome stain.

The deposits had entered the iris stroma through Fuchs' crypts, as was demonstrated by differential staining. The iris appeared rather solid and the vessel lumens were narrowed and, in some instances, obliterated. In none of these three eyes was the iris found to be in apposition with the lens surface, although it may have been so *in vivo*. There also was no evidence of posterior synechias.

The pigment epithelium in all three eyes had disintegrated and migrated in varying degrees. Pigment granules were found in and on the iris, on the posterior corneal sur-

face, and especially in the intratrabecular spaces. The disintegration and migration of the pigment was probably due to local malnutrition caused by clogging of the iris with the accretions. Apparently, it was not incidental to the rubbing action of the iris on the anterior lens surface, as has been considered by a number of authors. This type of pigment disturbance is not uncommon in aged individuals with degenerative diseases, and is usually attributable to arteriosclerosis and related angiopathy.

Indeed, the presence of pigment granules in the trabeculas of patients over 35 years of age is quite frequently seen clinically on gonioscopic examination as well as in microscopic sections. It is, moreover, a recognized clinical fact that glaucoma is produced by the clogging of the trabeculas with migrated pigment particles—a condition for which the name, pigmentary glaucoma, has been coined.

Since, in these three eyes, the accretions were found to be as numerous beneath the iris as they were in the pupillary areas, it does not seem likely that friction of the iris on the lens capsule is necessary in their formation or migration. Rather, it seems more likely that the accretions played a part in producing a secondary iris atrophy, thus promoting the degeneration and migration of the iris epithelium.

Fig. 3 (Theobald). Deposits (accretions) cling to ciliary processes (×430).

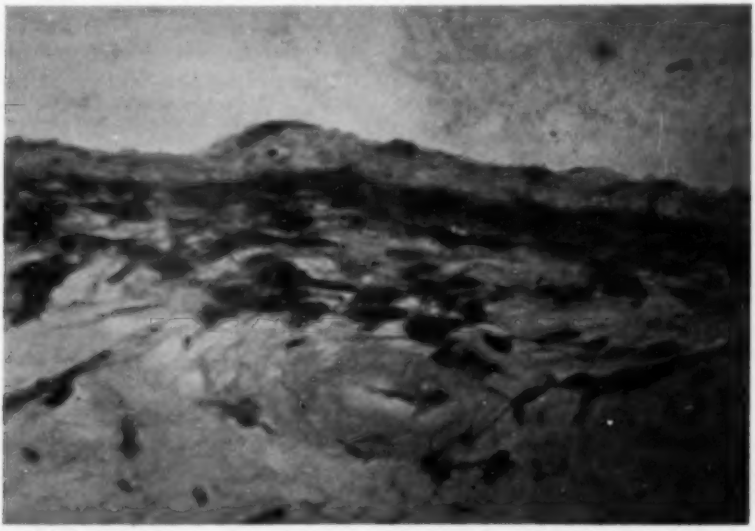

Fig. 4 (Theobald). Amorphous material in anterior chamber phagocytized by iris endothelium (×430).

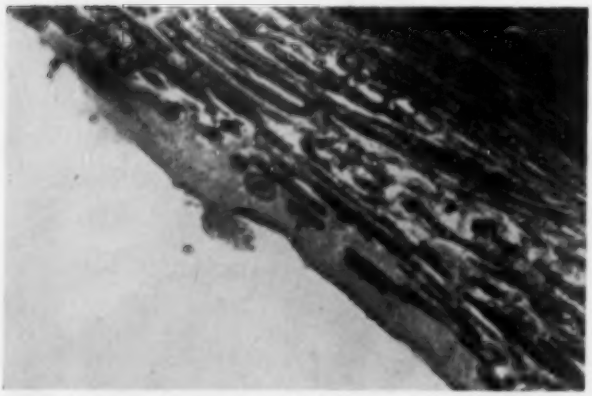

Fig. 5 (Theobald). Deposits line trabecular surface and fill intratrabecular spaces (×430).

The source and nature of these accretions are, however, obscure. The material does not have the histologic characteristics of lens capsule. Under high power, a thin, shiny membrane is seen between the lens capsule and the accretions on its surface (fig. 1) and the pericapsular membrane is intact.

Although these three cases exhibited the clinical picture which has been called "exfoliation of the lens capsule," it seems quite clear that, in these three eyes, there was no true exfoliation of the lens capsule and that these pseudo-exfoliations are merely capable of mimicking that condition.

## Re-evaluation of the literature

With the histopathologic findings presented by these three eyes in mind, it was

TABLE 1

Comparison of findings in pseudo-exfoliation and "true" exfoliation of the lens capsule

| | Pseudo-exfoliation | True Exfoliation |
|---|---|---|
| Age | Beyond fourth decade | Beyond fourth decade |
| Occupational | No | Yes (glass blowers, stokers, puddlers, heaters) |
| Clinical appearance | 1. Frostlike, roughened appearance of lens capsule | 1. Thin, homogeneous, water clear, transparent membrane that glistens |
| | 2. Roughened membrane detaches and curls forward away from lens surface | 2. Membrane curls like scroll or lamellae are loose and lie on lens surface as strands |
| | 3. Blue-gray, feltlike flakes, tufts, or fuzz, float in anterior chamber, fill angles, and are attached to iris and zonular fibers | |
| Pathology | 1. Accretions on anterior lens surface, on zonular fibers, and anterior vitreous membrane | (Pathologic material not available) |
| | 2. Phagocytized by endothelial cells of iris, cornea, and canal of Schlemm | |
| | 3. Block trabecular spaces | |
| | 4. Separated from lens by clear membrane | |
| Associated conditions | Eventually glaucoma | Eventually cataract |
| | May, but do not always, get cataract | May, but do not always, get glaucoma |

decided to review the literature on "exfoliation of the lens capsule" in order to determine which of the previous reports described "true" exfoliation and which described the condition characterized by accretions of an unknown substance and herein termed "pseudo-exfoliation."

This re-evaluation of the literature has shown that many of the cases clinically diagnosed as "exfoliation of the lens capsule" are, in reality, pseudo-exfoliation, and that the findings described herein as accretions have been repeatedly mistaken for "true" exfoliation.

## Diagnostic differentiation

In order to classify the criteria by which we are attempting to establish the two conditions as separate entities, a comparative outline is shown in Table 1.

The "true" exfoliation occurs in persons exposed to extreme heat over a long period of time. In them there is a rupture of the superficial layer of the capsule which either becomes shredded in appearance or curls up in a scroll-like manner. From the viewpoint of this study, it is unfortunate that no eye with "true exfoliation of the lens capsule" was available for histopathologic study.

Pseudo- (or false) exfoliation is caused by accretions of an unknown material which deposits itself upon the anterior lens surface and other structures in the anterior one half of the eyeball.

Although differential staining shows the presence of mucopolysaccharides and tyrosine, chemical analysis of the aqueous of these patients may lead to discovery of the real composition of these accretions.

As may be seen from Table 1, the clinical and pathologic criteria for differentiating pseudo-exfoliation of the lens capsule from "true" exfoliation can be clearly established, and Table 1 may be used as a basis for the classification of cases in the literature.

## Pseudo-exfoliation

"Exfoliation of the lens capsule" has been recognized as a pathologic condition for many years but it was not until 1925 that its causal relationship to wide-angle glaucoma was first clearly pointed out.

In that year, the Swiss author, Alfred Vogt, published in the *Klinische Monatsblätter für Augenheilkunde* the first complete and precise description of 16 cases, nine of them with glaucoma, the condition to which he later gave the name *Exfoliata superficiale capsulae anterioris*.

Some years before Vogt, Lindberg (1917), in Sweden, reported the presence of flakes at the pupillary border of the iris in about one half of 60 patients with chronic glaucoma, and believed these flakes to be mostly the result of earlier inflammatory exudate.

Another Swedish author, Malling, published (1923) his finding of "exfoliation" in 33 out of 88 cases of primary chronic glaucoma and called attention to the possibility of a relationship existing between the flakes and the increased intraocular pressure.

Vogt, as early as 1918, described the presence of a film with crinkled edges on the anterior lens capsule of a 72-year-old man who later developed glaucoma and thought that the film might consist of pupillary membrane remnants.

In 1923, Vogt examined the condition anew with a slitlamp and concluded that the film on the lens and the flakes on the iris were the result of exfoliation of the superficial layers of the lens capsule. Two years later, he published what has been generally accepted as the first complete and satisfactory description of "exfoliation of the lens capsule."

Vogt noted that the manifestation of this condition is independent of the pigmented iris epithelium and that the "exfoliations" consist of new masses which simply stick to the surface of that layer. He had observed them on the surface of the lens capsule, on the iris, or on the back of the cornea, and had found them to change from time to time in number and position. Simultaneously

with the blue, fluffy masses on the iris, he had noted a special condition on the anterior surface of the lens which had not previously been described.

On the pupillary border of the iris, he found light blue or white flocculi of a scaly, feltlike consistency and, in the center of the capsule, he observed a grayish disc about the size of the pupillary opening, which was surrounded by a clear black area, corresponding in size to the sphincter area of the iris. He also noted that the motion of the iris had abraded the grayish capsular lamella in this area, thus accounting for the debris on the pupillary edge of the iris.

Peripherally to this area, he found further evidence of the grayish membrane. The central edge was often curled forward and away from the capsule.

In brief, the capsule displayed, in most instances, superficial changes which were either central or peripheral, or both. The peripheral changes took the shape of a festooned ring or crown of fine, granular opacity, quite distinct from the disc just mentioned, or took the shape of a wheel, the radial zones of which were attached to the disc. The distal boundary of the crown stopped one or two mm. within the zone of attachment of the anterior fibers of the zonula. At this portion of the capsule, the distal edge of the crown curled on itself.

In the illustrations which supplement the article published by Vogt in 1925, some of the "exfoliations" (accretions) have the shape of tufts which are broadly attached to the capsule, while others are perched on thin pedicles and seem ready to drop off.

It has been observed by various workers that the flakes occur in relatively large numbers and are difficult to dissolve or absorb. They float in the anterior chamber and become attached to the iris and posterior corneal surface, choking the drainage angle in some instances, thus giving rise to glaucoma.

Busacca (1927), Garrow (1938), and others are in agreement with Vogt about the correctness of these findings. Garrow, for example, has described a milky film which was nonhomogeneous and had a dotted or grained appearance. The graining was of a fine texture in the center of a tear and coarser near its edge.

Sohby Bey (1932) found laminated masses on the pupillary margins and the posterior surface of the iris which were thicker in the furrows and thinner along the edges. He also noted that this material had the same refractile structure and characteristics as the lens capsule.

Depigmentation of the iris, Sohby Bey observed, went hand in hand with exfoliation. Furthermore, the massed formations, which crossed the angle from the pectinate ligament to the iris, he assumed to be accumulations of "exfoliated" capsular lamellae.

Another early observer, Hörven (1937), found zonular changes a constant characteristic and an integral part of the clinical picture whenever "exfoliation" was present and the suspensory ligament was at all visible. The fibers were, in all instances, seen to be densely covered with white scurflike particles which were also present on the pupillary border.

This condition has since been reported independently by many authors, especially when an iridectomy allowed them to view the posterior chamber. It is questionable, however, that the zonules undergo degenerative changes similar to those of the lens capsule.

In their paper, "Concerning lamellar membranes of the anterior surface of the lens," Holloway and Cowan (1931) report two distinctly different conditions (figs. 6, 7, 8, and 9).

Their first case is similar to the ones reported by Vogt and his followers (which I do not consider to be "true" exfoliation) in which the deposits on the anterior lens capsule are described as frostlike and wholly or partly covered with "blue-gray fuzz or scalelike opacities," many of them with ruptured edges.

The illustrations in this case of Holloway

Fig. 6

Fig. 7

Figs. 6 and 7 (Theobald). Deposits on anterior lens surface, diagnosed clinically as capsular exfoliation. (From Holloway and Cowan, Am. J. Ophth., **14**:189-195, 1931.)

and Cowan (figs. 6 and 7) correspond with those of Vogt and others and are excellent examples of pseudo-exfoliation.

In discussing their Case 1, Holloway and Cowan say:

"Since Vogt's observation, similar cases have been reported. . . . All of these cases are strikingly similar: many of the gray flakes, scales, or plaques have free, curled margins, while at times similar membranous tags are adherent to the pupillary margin and to the posterior surface of the cornea.

"The majority of observers now regard this type of case as due to degeneration of the zonular lamella. Wollenberg, Alling, and Vogt are practically in accord in their belief that the distribution of the flakes, and doubtless their adherence to the pupillary margin, depend upon the normal movements of the iris.

"In this type of case, the pupillary area is generally practically free and most of the manifestations are behind the iris. Kraupa prefers to regard these as dependent upon senile changes, in contradistinction to the type of case presently to be described (Holloway and Cowan's Cases 2 and 3 (figs. 8 and 9)) where the manifestations are chiefly in the pupillary area and which are frequently observed in glass workers, puddlers, and blacksmiths (doubtless chainmakers and tinplate workers would also show these changes). Kraupa is also of the opinion that the central area, which is generally clear, may ultimately show similar changes.

"Schieck . . . regarded these manifestations as deposits upon the lens surface. He believed the posterior iris cells to be the origin of the disturbance. Still later, Busacca and Hoorgina looked upon it as a deposition; the latter expressing the opinion that it was due to the action of a chemically changed aqueous upon the lenticular surface."

Concerning the cause and implications of this capsular change (pseudo-exfoliation), reference should be made to the clarifying views contributed notably by Vogt, Trantas, and Hörven.

Vogt said that the capsular changes might be in the nature of sclerosis. Trantas (1932) suggested that the capsular lesions might be the result of senile degenerative changes which attacked not only the anterior capsule but also most of the other ocular tissues as

Fig. 8 Fig. 9

Figs. 8 and 9 (Theobald). Showing "true" exfoliation of lens capsule. (From Holloway and Cowan, Am. J. Ophth. **14**:189-195, 1931.)

well, and especially the glass membranes and the transparent media, including the vitreous body. Consequently, the capsular surface would take on the appearance of having been sprinkled with powder. Corresponding changes occurring in the excretory channels for the intraocular fluids would then explain the tendency toward glaucoma. The "exfoliations" which become free in the aqueous would be deposited in the angle of the anterior chamber, thereby adding to the obstruction of the degenerated pectinate ligament and also of Schlemm's canal.

Trantas also observed that the size of the disk was not the same as that of the pupil in old age, and that therefore the edge of the disk was not fashioned by the pupillary action on the lens.

Furthermore, both Trantas and Vogt agree that a second "exfoliation" may superimpose itself on a pre-existing one, thus indicating that all the superficial capsular lamellae take part in the degenerative process progressively.

### "True" exfoliation

Although the use of ordinary stains gives the impression that the lens capsule is structureless, maceration and the application of special staining methods reveal it to be a composite structure, that is, to consist of several layers.

Busacca (1928), Berger, and Elschnig are agreed as to the presence of a pericapsular membrane. Some authors believe that the pericapsular membrane and zonular lamella are one and the same structures; while others are of the opinion that the zonular lamella is confined to the equatorial region. However, "true exfoliation of the lens capsule" affects first the pericapsular membrane and then the capsule itself.

"True exfoliation of the lens capsule" has been described clinically by a number of authors but, of the cases recorded in the literature, Cases 2 and 3 of Holloway and Cowan (1931) are of particular interest and value in pointing out the differences between this condition and the pseudo-exfoliation so frequently mistaken for it. The illustrations taken from Holloway and Cowan (figs. 8 and 9) show with dramatic clarity how the slightly serrated, glistening, curled-up or scroll-like margins of "true" exfoliation de-

pict a condition entirely different from pseudo-exfoliation.

The second case described by Holloway and Cowan was that of a man, aged 70 years, who had been a puddler and heater in a rolling mill for 40 years. The illustration of this patient's condition (fig. 8) shows entirely different findings from those in their first case (figs. 6 and 7), as well as from those found in the cases herein described—"the curled margins of a homogeneous transparent membrane which were slightly serrated and glistening, and projected into the anterior chamber."

The third case reported in the paper by Holloway and Cowan showed a similar "thin homogeneous transparent membrane that curled upward and rolled up much like a scroll." See Figure 9.

In 1922, Elschnig reported three cases of lamellar exfoliation occurring in glass blowers and described the exfoliation as "water-clear membranes." In 1930, Vogt reported capsular exfoliations in an 80-year-old man who had been observed over a period of a year before his death. The lamella became loose and lay on the anterior lens surface. In this case, the histologic sections showed a "true" exfoliation of the lens surface in horizontal strands. This would well illustrate the findings in Holloway and Cowan's second and third cases, but is entirely different from the picture seen in my three cases.

In discussing their second and third cases, Holloway and Cowan remark:

"The vast majority of patients exhibiting changes of this character have been exposed to undue and prolonged heat; in a few instances, such as Case 3, this has not been the case."

Elschnig differed from Kraupa as to the origin of the rupture in the lens capsule. He believes that the rupture and detachment are the result of the heat changing the elasticity of the zonula rather than a diminution in the size of the lens.

Kraupa later stated that the genesis of this type of capsular detachment was not known. He was not, however, prepared to accept the opinion of Elschnig but he stated that a change in volume did occur in glass workers' cataract and that this might lead to protrusion of the lamella. He had also noted a rupture of the lens capsule lamella following a severe contusion of the globe. He further stated that the entire anterior layer of the capsule may detach in the form of a flat vesicle and subsequently rupture. Following this, there may be some adherence to the capsule.

Verhoeff, in conjunction with Bell and Walker, noted that glass blowers' cataract was produced by heat.

Holloway and Cowan, in continuing their discussion, make what seems to me a particularly revealing statement indicating that confusion existed in Vogt's mind concerning the cases which he had reported:

"Vogt (1929) excluded heat and attributed it ('true' exfoliation) to the infrared rays, and stated that, in addition to the axial lens opacities, a partial or complete detachment of the anterior lamella of the anterior lens capsule may occur. These changes were only found in those over 40 years of age; therefore, age must be a factor. He believed the same process was involved in those cases that developed capsulocuticular glaucoma, except that in these individuals the cuticle was fragile and crumbled, while in the other instance the membrane retained its elasticity."

## Comment

Needless to say, the literature on exfoliation of the lens capsule has increased considerably since the notable publications of Vogt, Busacca, Trantas, and Hörven, as may readily be seen by consulting the bibliography which Berliner has included in volume II of his *Biomicroscopy of the Eye* (1949).

Four years after Vogt described glaucoma capsulocuticulare, Dr. Robert von der Heydt saw his first case at the Illinois Eye and Ear Infirmary. His enthusiasm and teaching led to the search for and study of many such cases, 77 of which were reported by Gradle

and Sugar in 1947. Many other cases of capsular "exfoliation" are presently under observation at the Glaucoma Clinic of the Infirmary, and data are constantly being collected on the relation of this condition to glaucoma.

## Summary and Conclusions

1. Three cases are reported which clinically were diagnosed as "glaucoma with exfoliated lens capsule." Pathologically these cases did not show exfoliation of the lens capsule but rather precipitates or accretions of an unknown substance in the anterior segment. I propose to call this condition "pseudo-exfoliation of the lens capsule."

2. Many of the cases previously described in the literature as capsular exfoliation are in reality "pseudo-capsular exfoliation." An attempt has been made to separate these into two distinct clinically and pathologically recognizable entities.

3. In the posterior chamber, the accretions clung to the posterior surface of the iris, ciliary body, zonular fibers, and to the anterior limiting membrane of the vitreous.

4. In the anterior chamber, the accretions were not only loosely attached to the iris, cornea, and trabeculum, but were phagocytized by the endothelium lining these structures.

5. The debris invaded the iris, filled the intratrabecular spaces and even the canal of Schlemm, thus blocking all avenues of egress for the aqueous, thereby producing a condition directly favoring an increase in intraocular pressure.

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## References

Berliner, M. L.: Biomicroscopy of the Eye. New York, Hoeber, 1949.

Busacca, A.: Ueber ein neues Slitlampenbild in die Aequatorial-region der Linse. Klin. Monatsbl. f. Augenh., **79**:518, 1927.

———: Zonullalamelle Ablösung des Linsenkapselhäutchens oder Häutchenniederschlage. Klin. Monatsbl. f. Augenh., **85**:823, 1938.

Elschnig: Klin. Monatsbl. f. Augenh., **69**:732, 1922; **70**:325, 1923.

Garrow, A.: Exfoliation of the lens capsule in glaucoma. Brit. J. Ophth., **22**:214, 1938.

Gradle, H. S., and Sugar, H. S.: Glaucoma capsulare. Am. J. Ophth., **30**:12-19, 1947.

Holloway, T. B., and Cowan, A.: Concerning lamellar membranes of the anterior surface of the lens. Am. J. Ophth., **14**:189-195 (Mar.) 1931.

Hoorgina: Russian Ophth. J., 1929. (Abstract: Am. J. Ophth., **13**:78, 1930.)

Hörven, E.: Exfoliation of the superficial layer of the lens capsule (Vogt) and its relation to glaucoma simplex. Brit. J. Ophth., **21**:625, 1937.

Lindberg, J. G.: Kliniska ov underosokingar over dipigmentaringen ov pupillenranden. Helsingfors, 1917.

Malling, B.: Untersuchung ueber das Verhältniss zwischen Iridocyklitis und Glaukom. Acta Ophth., **1**:97, 1923.

Sohby Bey, M.: Contribution to the study of exfoliation of the lens capsule or glaucoma capsulocuticulare with anatomical preparations. Brit. J. Ophth., **16**:64, 1932.

Sugar, H. S.: The Glaucomas. St. Louis, Mosby, 1951.

Trantas: Lesions seniles de la capsule anterieure du cristallin et bord pupillaire. Arch. d'ophtal., **46**: 482, 1929.

Vogt, A.: Der Alterstar, seine Heredität und eine Stellung zu exogener Krankheit und Seniums. Ztschr. f. Augenh., **40**:123, 1918.

———: Erster histologischer Befund von Linsen Kapselpräzipitäten. Klin. Monatsbl. f. Augenh., **101**: 705, 1938.

———: Ein neues Spaltlampenbild des Pupillengebietes: Hellblauer Pupillensaumfilz mit Häutchenbildung auf der Linsenvorderkapsel. Klin. Monatsbl. f. Augenh., **75**:1-12, 1925. (Eight beautifully colored plates supplement this article.)

———: Neue Fälle von Lensenkapselglaukom (Glaucoma capsulare). Klin. Monatsbl. f. Augenh., **84**:1, 1930.

# DECREASE IN INTRAOCULAR PRESSURE IN MAN BY A CARBONIC ANHYDRASE INHIBITOR, DIAMOX*

A PRELIMINARY REPORT

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A remarkably high concentration of bicarbonate in the posterior chamber of the rabbit eye has been reported recently by Kinsey.[1] This finding tended to confirm Friedenwald's[2] hypothesis of an active transfer of electrolytes into the eye by the ciliary body. Carbonic anhydrase, the enzyme that catalyzes the rapid interconversions of carbon dioxide and bicarbonate, has not yet been implicated in this transfer. The accumulation of bicarbonate in the eye, however, would make it seem likely that such an enzyme plays an essential role in the formation of the aqueous humor. The recent availability of extremely potent carbonic anhydrase inhibitors[3] suggested an exploration of the effects of such agents on the intraocular pressure and dynamics.

Diamox† (2-acetylamino-1,3,4-thiadiazole-5-sulfonamide) has proved to be an effective inhibitor of carbonic anhydrase which can be administered with safety to human subjects. Since it inhibits renal tubular reabsorption of sodium bicarbonate, Diamox has received considerable attention as a diuretic for patients with congestive heart failure.[4] In experimental animals it also inhibits gastric[5] and pancreatic[6] secretion.

## PRESENT STUDY

Diamox was administered orally in single doses of 500 to 1,000 mg. to 19 patients. No side reactions or toxicity were noted following single doses, but two patients complained of paresthesias of fingers and toes after repeated administrations. Tonometric measurements were made on all patients and in most instances tonographic tracings were obtained. There were included in this series 25 eyes of 15 patients with various types of glaucoma uncontrolled by conventional treatment. Ten eyes of six patients were considered completely normal. The results are recorded in Table 1.

It is evident that there was a pronounced decrease in intraocular pressure in every instance. Following a single administration of Diamox, the pressure began to fall in 60 to 90 minutes, reached a minimum in three to five hours, and returned to initial levels in eight to 12 hours. The intraocular pressure could be lowered just as promptly by a second dose. In general, the higher the intraocular pressure, and the lower the facility of outflow, the longer the time required for the pressure to fall to normal limits.

Tonographic tracings usually revealed just as flat curves at the lower pressure levels as at the initial elevated tension, that is, the fall in intraocular pressure was accomplished without measurable change in facility of outflow. This would suggest that the decreased pressure induced by Diamox was a result of inhibition of rate of inflow of aqueous. The 10 normal eyes in the series responded similarly but with much smaller decreases in pressure.

It is apparent that Diamox is an effective agent in lowering intraocular pressure. It should prove very useful preoperatively in glaucomatous eyes which fail to respond to miotics and other measures. It may also be of great help in tiding patients over acute inflammatory crises or traumatic episodes with secondary glaucoma. For example, the patient J. J. was so treated for traumatic

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TABLE 1

EFFECT OF ORAL DIAMOX ON INTRAOCULAR PRESSURE

| Patient | Age (years), Race, and Sex | Diagnosis | Dose (mg.) | Intraocular Pressure* (mm. Hg) Before Diamox | After Diamox |
|---|---|---|---|---|---|
| J. J. | 10 CM | Traumatic hyphema, R.E. | 500 | R.E. 42 | 14 |
| W. H. | 60 CM | Open-angle glaucoma, O.U. | 500 | R.E. 37 | 21 |
| | | | | L.E. 40 | 21 |
| C. W. | 24 CF | Old interstitial keratitis with secondary glaucoma, O.U. | 1000 | R.E. 48 | 12 |
| | | | | L.E. 38 | 11 |
| M. D. | 80 CF | Secondary glaucoma following cataract extraction, R.E. Normal, L.E. | 500 | R.E. 43 | 27 |
| | | | | L.E. 20 | 10 |
| T. M. | 32 CM | Secondary glaucoma, O.U. Iridencleisis, O.U., one year before. Cyclodiathermy, L.E., 10 months before | 500 | R.E. 36 | 15 |
| | | | | L.E. 23 | 9 |
| A. C. | 56 CF | Chronic open-angle glaucoma, O.U. | 1000 | R.E. 66 | 27 |
| | | | | L.E. 54 | 21 |
| M. H. | 41 CF | Inactive uveitis with secondary glaucoma, R.E. Iridectomy, trephination, two cyclodialyses and one cyclodiathermy, R.E. | 1000 | R.E. 40 | 11 |
| C. R. H. | 44 WM | Inactive uveitis with secondary glaucoma, R.E. Trephination 5 months ago. | 500 | R.E. 39 | 15 |
| R. G. | 57 CM | Inactive uveitis with secondary glaucoma, O.U. | 1000 | R.E. 42 | 15 |
| | | | | L.E. 55 | 20 |
| G. F. | 45 WF | Uveitis with secondary glaucoma, O.U. | 500 | R.E. 55 | 21 |
| | | | | L.E. 45 | 16 |
| C. H. | 42 CF | Open-angle glaucoma, O.U. Anterior sclerectomy, R.E., 6 months before. | 500 | R.E. 40 | 25 |
| | | | | L.E. 38 | 21 |
| P. B. | 61 CF | Open-angle glaucoma, O.U. Trephination, L.E., 9 years before. | 500 | R.E. 39 | 17 |
| | | | | L.E. 18 | 14 |
| M. G. | 63 CF | Secondary glaucoma, O.U., following cataract extractions. | 500 | R.E. 76 | 22 |
| | | | | L.E. 72 | 20 |
| I. W. | 76 WF | Secondary glaucoma, O.U., following cataract extractions. | 500 | R.E. 45 | 21 |
| | | | | L.E. 77 | 21 |
| J. P. | 15 WM | Traumatic cataract and secondary glaucoma, R.E. Normal, L.E. | 500 | R.E. 63 | 25 |
| | | | | L.E. 19 | 14 |
| E. A. | 67 CF | Normal, O.U. | 500 | R.E. 17 | 12 |
| | | | | L.E. 17 | 12 |
| F. M. | 44 CM | Normal, O.U. | 500 | R.E. 15 | 11 |
| | | | | L.E. 15 | 11 |
| M. T. | 52 CF | Normal, O.U. | 500 | R.E. 17 | 14 |
| | | | | L.E. 17 | 14 |
| V.D. | 42 CF | Normal, O.U. | 500 | R.E. 19 | 17 |
| | | | | L.E. 19 | 17 |

* Intraocular pressures measured with electronic or Schiøtz tonometers.

hyphema and secondary glaucoma, and has had no further elevations of intraocular pressure following cessation of Diamox administration.

Work is in progress to evaluate the feasibility of continued administration of Diamox in patients with chronic glaucoma.

It is important to note that the ocular toxicity of this drug has not yet been determined. It has been given daily to cardiac patients for periods as long as 14 months without reported untoward effects. A careful study of such patients for ocular complications would be most helpful. If it is to be used preoperatively in patients with glaucoma, the question of the possible increased risk of general anesthesia in Diamox-treated patients must be considered.

Most important will be the experimental investigation of the mode of action of this agent, whether it directly inhibits the secretory mechanism of the eye, or whether the fall in intraocular pressure is secondary to the induced systemic electrolyte alterations.

It is hoped that this preliminary report will stimulate the cautious use of Diamox

so as to accumulate more rapidly a large clinical experience with this drug.


## Summary

The carbonic anhydrase inhibitor, Diamox, is an effective agent in lowering intraocular pressure in man when administered in oral doses of 500 to 1000 mg.


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## References


1. Kinsey, V. E.: Comparative chemistry of aqueous humor in posterior and anterior chambers of rabbit eyes. A.M.A. Arch. Ophth., **50**:401, 1953.
2. Friedenwald, J. S.: Dynamic factors in the formation and reabsorption of aqueous humor. Brit. J. Ophth., **28**:503, 1944.
3. Miller, W. H., Dessert, A. M., and Roblin, R. O., Jr.: Heterocyctic sulfonamide as carbonic anhydrase inhibitors. J. Am. Chem. Soc., **72**:4893, 1950.
4. Friedberg, C. K., Halpern, M., and Taymor, R.: The effect of intravenously administered 6063, the carbonic anhydrase inhibitor, 2-Acetylamino-1,3,4-Thiadiazole-5-Sulfonamide, on fluid and electrolytes in normal subjects and patients with congestive heart failure. J. Clin. Invest., **31**:1074, 1952.
5. Janowitz, H. D., Colcher, H., and Hollander, F.: Inhibition of gastric secretion of acid in dogs by carbonic anhydrase inhibitor, 2-Acetylamino-1,3,4-Thiadiazole-5-Sulfonamide. Am. J. Physiol., **171**:325, 1952.
6. Birnbaum, D., and Hollander, F.: Inhibition of pancreatic secretion by the carbonic anhydrase inhibitor 2-Acetylamino-1,3,4-Thiadiazole-5-Sulfonamide, Diamox (6063). Am. J. Physiol., **174**:191, 1953.


# GLIOMA OF THE OPTIC NERVE*

### As a manifestation of von recklinghausen's disease


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## Introduction

Although glioma of the optic nerve is uncommon, it is often a manifestation of von Recklinghausen's disease or neurofibromatosis,[1] a much more common and a systemic disease that may involve any structure in the body. The purpose of this paper is to reemphasize that relationship. As background for a clinical study of glioma of the optic nerve, von Recklinghausen's disease will be concisely reviewed, a case reported, and brief attention given to the principles of management.

The literature on these subjects is so full that further discussion would be unjustified were it not for the fact that the close and frequent association of optic-nerve and chiasmal glioma with von Recklinghausen's disease is not widely recognized. With hundreds of instances of glioma now reported, a high proportion make no mention of the presence or absence of other evidences of von Recklinghausen's disease, either in the patient or in his near relatives.

Several authors have discovered the disease to be present when they carefully reexamined their patients.[2] Following the exhaustive monograph by Davis,[3] in 1939, Verhoeff,[4] Reese,[5] and several others,[6-9] have acknowledged the importance of von Recklinghausen's disease to optic-nerve tumors. As stated by Reese,[5] "It remained for Davis to amplify the subject and to present it convincingly as an accepted fact."

In contrast, a recent superb text on ophthalmic pathology[9] casually mentions the possible relationship, and at once casts it aside. An excellent paper[10] published a year ago, while reporting the association as present in

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TABLE 1

GENERAL MANIFESTATIONS OF VON RECKLINGHAUSEN'S DISEASE

A. SKIN
1. Pigmented spots: café-au-lait
2. Tumors: molluscum fibrosum
3. Subcutaneous neurofibromatous nodule
4. Nevus
5. Alopecia

B. SOFT TISSUES
1. Hypertrophy, elephantiasis, as of extremity
2. Plexiform neurofibroma
3. Vascular: hemangioma, lymphangioma
4. Tumor; viscera, mediastinum, vocal cord, etc.
5. Endocrine dysfunction

C. EYE AND ADNEXA
See Table 2

D. CENTRAL NERVOUS SYSTEM
1. Tumors brain
2. Tumors cranial nerves
3. Tumors spinal cord
4. Tumors peripheral nerves
5. Sensory or motor disturbance
6. Defective sight, hearing, etc.
7. Palsy vocal cord; vestibular changes, etc.
8. Mental defects
9. Syringomyelia

E. BONE
1. Local hypertrophy, abnormal growth
2. Scoliosis, kyphosis, paraplegia
3. Defect vertebral body
4. Spondylolisthesis
5. Congenital bowing of leg
6. Subperiosteal cysts
7. Defects, erosion in skull bones
8. Congenital pseudarthrosis
9. Melorheostosis

F. MULTIPLE TUMORS
1. Multiple tumor types
2. Related to tuberous sclerosis

G. MALIGNANCY
1. Sarcomatous degeneration

H. HEREDITY
1. Simple dominant

50 percent of their series, made only the simple statement. "The relationship to von Recklinghausen's must be mentioned, since the two are often combined."[10] It almost seems that European ophthalmologists generally are more aware of the relationship than those in the United States.[1, 7, 8, 11]

It would appear worth while again to assess the facts indicating that this association is not fortuitous, is not even rare, and is now supported by enough cases to bar any doubt of the relationship.[7]

## VON RECKLINGHAUSEN'S DISEASE

This is not the place to embark on a detailed analysis of von Recklinghausen's disease, but a quick recapitulation of its characteristics, as in Table 1, will serve as a useful background for a study of optic nerve gliomas. Von Recklinghausen's neurofibromatosis is a hereditary disease of the nervous system, characterized by the formation of tumors in various tissues and organs, and by cutaneous pigmentation. The tumor changes, in turn, may produce pleomorphic alterations in adjacent tissues, which have resulted in the disease being subdivided into types according to the system and location involved.[12] Its incidence in the general population is one in 2,000.

The clinical condition was first described in 1835 by Rayer[13] and later was named after the man whose paper appeared in 1882.[14] It appears in all races, and must be ascribed to a disturbance in the germ plasm affecting ectomesodermal development. There is disagreement over whether it is a neoplasia or dysplasia,[11] and whether it is basically a fault of the mesoderm or is neurogenic.[1, 12] It is closely related to tuberous sclerosis,[1] and the two conditions have been reported present simultaneously[15, 16] but probably have different genes.[1]

The disease may be evident in the newborn.[1, 17, 18]

### SKIN

In the skin, pigmented areas of melanic origin, sharply defined and variable in size, shape, and location, may be present, known as café-au-lait spots because of their light tan color. They are more prevalent in unexposed areas, and may be present at birth or develop in the early decades. About 10 per-

cent of the normal population may show a very few, and grossly and histologically they do not differ from the macular pigmentation that may be found in normal individuals.[20]

Café-au-lait spots alone are proof of the presence of von Recklinghausen's disease provided they are at least six in number, and each is of at least 15 mm. in diameter.[20] Some authors are still more liberal in making the diagnosis on the sole evidence of the pigmented spots.[21]

Fibromas in cutaneous nerves may be present as tumors in the skin, elevated or pedunculated above the surface, or lying subcutaneously. Along peripheral nerves, neurofibromas may show as movable and occasionally tender, firm tumors beneath the skin, similar to lipomas. They may lie still deeper, involving viscera in the abdomen[22] or thorax.[23] Rarely they may involve the palm of the hands, the lid border to cause trichiasis,[24] and the scalp. Locally, the process may be more extensive and diffuse, forming a plexiform neuroma, which is often accompanied by hypertrophy of adjacent skin and soft tissues, sometimes termed elephantiasis.[25]

### Bone

The disease in osseous nerves causes frequent and sometimes deforming changes in the skeleton.[26, 27] The incidence of osseous defects is at least 27 percent.[19] Scoliosis and kyphosis are frequent.[28] Hypertrophic and cystic changes occur, severe bowing of long bones and even pseudarthrosis.[29] Paraplegia may result from a severe spinal deformity,[30] and spondylolisthesis and melorheostosis have recently been reported.[28] The jaws may be involved,[31] and the orbital walls are frequently eroded.[32, 33]

### Central nervous system

Von Recklinghausen's disease may involve any part of the central nervous system, including any cranial nerve, the brain,[18, 34] the spinal cord[35] and its branches. There may be one tumor or hundreds.[34] They may be gliomas, meningiomas, or other histologic types[36] and, as would be expected, various neurologic signs of cord or brain tumor, of pressure or palsy, may result.

By affecting the adrenals, pituitary, or other hormonal control centers, endocrine dyscrasias may evolve, and mental or intellectual changes are not uncommon.

Obviously, this disease, like multiple sclerosis and syphilis, may manifest itself in any part of the body. Patients who have marked central involvement tend to have only minor or late skin manifestations.[20]

### Eye and adnexa

In our own special field the disease may be encountered in every structure except lens and vitreous,[37] from lids to chiasm, from cornea to optic disc, in the orbit,[38] and in the globe.[4, 39] The possibilities are listed in Table

TABLE 2

Ocular manifestations of von Recklinghausen's disease

A. Globe and Pathways
1. Conjunctiva: neurofibromatous tumors
2. Cornea: nodules and nerve enlargement
3. Uvea: neurofibromatous tumors, ? melanoma
4. Retina: tumors
5. Nerve and chiasm: glioma, meningioma
6. Optic pathway: glioma, other tumors

B. Adnexa
1. Lids:
   a. Plexiform neurofibroma
   b. Fibroma molluscum, thickened skin
2. Orbit:
   a. Walls: bony defects, asymmetry
   b. Contents: neurofibromas
   c. Optic canal: enlargement by tumor

C. Clinical Symptoms and Signs
1. Ptosis
2. Strabismus
3. Proptosis (may be pulsating)
4. Rarely enophthalmos
5. Visual failure, optic atrophy
6. Buphthalmos, glaucoma
7. Trichiasis
8. Abnormal function of nerves
9. Visual field changes
10. Papilledema
11. Hypermetropia

2. Allende lists the ocular tissues as follows, in the order of decreasing frequency of their involvement by neurofibromatosis: lids, optic nerve, orbit, retina, iris, cornea, tarsal conjunctiva, bulbar conjunctiva.[40]

### Heredity

Von Recklinghausen's disease is inherited usually as a simple dominant trait.[1, 41] It may show great intrafamilial variability, but whether it can be truly recessive, or can skip a generation, is doubtful.[41, 42] However, in the case reported by Tanner and Hertzog,[43] later study revealed signs of von Recklinghausen's disease in brother, sister, maternal grandmother, and aunt, even though the child patient, and his mother and father, showed no apparent manifestations. It has been reported twice in identical twins,[7, 44] and proven in six successive generations.[42, 45] One half of the offspring of affected individuals may be expected to have the disease, but offspring of a truly unaffected individual will be normal. Latent inheritance or mutation would explain an affected child from a phenotypically normal parent.[1] Parents should be instructed in the nature of the disease and the probability of their children having it.

### Multiple tumors

This condition, probably because it is basically neurogenic, unites a multitude of tumors under one roof, a relationship occurring too often to be passed off as mere coincidence. Choroidal malignant melanoma has occurred with pigmented nevi and cutaneous neurofibromas.[46, 47] Meningioma, acoustic tumor, and multiple neurofibromas of the cranial and peripheral nervous system have been present in the same individual.[26, 48] Lipomatosis, nevi, schwannoma, meningioma, and glioblastoma have been associated in one individual with von Recklinghausen's disease.[49]

### Abortive forms

The incomplete form of von Recklinghausen's disease, known by the French as "forme fruste," was first described in 1898 and is very common. The term is one of degree only, indicating an individual who shows relatively few evidences of the disease. It is therefore frequent in the children of diseased parents, for manifestations may be delayed in appearance until anywhere in the first four decades.[50] For example, a child may show only café-au-lait spots, or perhaps only an optic-nerve glioma, and not until later show skin tumors or other signs of the disease.

Establishing a diagnosis of von Recklinghausen's disease may therefore be difficult, especially in children, and obviously a careful, complete physical examination of the patient as well as a study of all relatives possible becomes increasingly essential. How few signs can justify a diagnosis is an important question. An awareness by the examiner of all the possible evidences may swing the balance.

### Malignancy

A final important characteristic of the disease is the possible development of malignant sarcoma.[51, 52] Although reported in a frequency as high as 13 percent, Crowe believes this figure is based on partially selected cases, and the true incidence of malignant change is considerably less. Most patients die with and not of the disease.[42] Sarcomatous degeneration may occur in children.[53]

Most pointedly, one author has described neurofibromatosis as a "systemic disease easily diagnosed, little studied, and seldom cured."[54]

Another, seeking to stimulate professional interest in the disease, has commented at greater length. "The clinical significance of a disease is increased by its frequency. . . . When a clinical entity, seemingly unusual, proves, by reason of its varied characteristics, to be more common than previously thought, its significance increases. Any disease, even an unusual one, which in the majority of instances is benign but which in

some develops to a malignant stage, is definitely significant. . . . Multiple neurofibromatosis, like leukoplakia, deserves respect as well as watching."[88]

### Glioma of the optic nerve

Primary tumors of the optic nerve and chiasm are uncommon. To this time 660 cases have been recorded in the literature, and in 108 cases von Recklinghausen's disease was known to be associated, or in 16.4 percent. Since about 75 percent of all primary optic nerve tumors are gliomas, then the literature to this time records an association of von Recklinghausen's diseases with optic or chiasmal glioma in 21.8 percent of cases.

Awareness of this association is becoming more widely known. In 1944, Bürki found a figure of 37.6 percent if reports of only the preceding 10 years were tabulated.[8] More recently, in the literature from 1940 through 1951, there were reported approximately 160 gliomas of the optic nerve or chiasm. Among these, 60 were in association with von Recklinghausen's disease, a percentage of 37.5.

Yet, among the 160 most recent reports, in 81 no mention was made of whether or not von Recklinghausen's disease was otherwise evident, and in only 19 was the statement made either that the general physical examination was negative, or that there was no external evidence present of neurofibromatosis.

The proportion of cases in which optic nerve glioma and von Recklinghausen's disease occur together is quite certainly actually higher than the figures just stated. Christensen and Andersen in 12 patients found von Recklinghausen's disease present in six, or 50 percent.[10] Davis alone has personally seen 15 cases.[101] In several known instances, reexamination of the patient or his relatives has revealed evidences of von Recklinghausen's disease that were present but overlooked or ignored at the original examination.

In about 30 percent of cases of glioma of the chiasm, a generalized von Recklinghausen's disease is found associated.[56] The cases

TABLE 3

Glioma of the optic nerve or chiasm in association with von Recklinghausen's disease

(Supplement to list by F. A. Davis, 1939)

| Author | No. | Year |
|---|---|---|
| Wiegmann[105] | 1 | 1922 |
| Reverdin and Grumbach[106] | 1 | 1925 |
| Weigelin[108] | 1 | 1935 |
| Brinton[84] | 1 | 1937 |
| Meyer[104] | 1 | 1939 |
| Beck[102] | 1 | 1939 |
| Schmidt[86] | 3 | 1939 |
| Rand, Irvine and Reeves[76] | 1 | 1939 |
| Schneider[88] | 1 | 1940 |
| Tanner and Hertzog[43] | 1 | 1940 |
| Goldmann and Grunthal[57] | 1 | 1941 |
| Pfeiffer[58] | 7 | 1941 |
| Rettelbach and Schutzbach[89] | 1 | 1942 |
| Braendstrup[90] | 1 | 1944 |
| Bürki[8] | 2 | 1944 |
| Pugh[91] | 1 | 1946 |
| Granroth[92] | 1 | 1946 |
| Harvey[42] | 1 | 1946 |
| Godtfredsen[96] | 4 | 1947 |
| Meadows[93] | 1 | 1948 |
| Goldsmith[57] | 1 | 1949 |
| Dresner and Montgomery[7] | 3 | 1949 |
| Löhlein and Tönnis[94] | 2 | 1949 |
| Paufique and Etienne[95] | 1 | 1949 |
| Bodechtel[97] | 3 | 1950 |
| Kirby[15] | 7 | 1951 |
| Borberg[1] | 2 | 1951 |
| Cohen[98] | 1 | 1951 |
| Paillas[99] | 1 | 1951 |
| Mecca[100] | 1 | 1952 |
| Christensen and Andersen[10] | 6 | 1952 |
| Davis[101] | 9 | 1953 |
| Marshall | 1 | 1953 |
| Total | 70 | |

of optic nerve and chiasmal glioma with this relationship, which have been added since the monograph by Davis in 1939,[8] are listed in Table 3. An exact count is difficult and impossible for several reasons. Published information is sometimes incomplete, or the author may himself have had uncertainty as to the correct ocular or systemic diagnosis.[15, 57-60]

Often optic-nerve glioma is assumed and probable as the cause of clinical or roentgenologic signs, but without surgical evidence some doubt and uncertainty must remain. There is possible duplication of case reports in some papers.

Regardless of the exact number of reported cases, and the exact frequency with which glioma and von Recklinghausen's dis-

ease are associated, the correlation is so high that it must never be ignored.

The more carefully search is made on the patient and among his relatives, the greater will be the frequency with which von Recklinghausen's disease will be discovered. Frequently further signs will appear as the patient grows older. Visual defects, optic atrophy, and enlarged optic canals are surprisingly frequent in neurofibromatosis.[7] Unsuspected glioma of nerve or chiasm often is the cause.

A possible relationship between optic-nerve tumors and von Recklinghausen's disease was suggested over 50 years ago by Byers and Emanuel. In this country, the only thorough study of the subject published was that of Davis in 1939,[3] and recently the splendid text by Reese on tumors of the eye[5] devotes several pages to the problem, and lends full support to Davis. In the same dozen years valuable contributions have appeared in Europe, indicating that, in the United States, we either are less aware of the relationship or are less eager to write about it. A few of the more important papers deserve specific mention.

Rettelbach and Schutzbach,[39] in 1942, made a very complete review of the literature and reported one case. Still more outstanding and exhaustive was the work of Bürki in 1944,[2] who, by combing world publications far more meticulously than his predecessors, was able to prove that glioma of the optic nerve is associated with von Recklinghausen's disease in a known third, and very likely a higher proportion, of cases. He concluded, echoing Davis, that in many, if not in all, cases the primary optic-nerve tumor is only one symptom of a more widely disseminated disease; that it may represent the first or only symptom of von Recklinghausen's disease; and he reiterated the urgency of examining all young patients with the tumor for evidences of von Recklinghausen's disease and, if none are found, a search in the patient's family.

In this period three excellent works have come from Denmark. Braendstrup[30] in 1944, and Christensen and Andersen,[10] in 1952, each writing on primary tumors of the optic nerve, noted the relationship of glioma to von Recklinghausen's disease, and urged careful search for manifestations, but did not emphasize it, even though the relationship was present in half of the 12 gliomas reported by the latter authors.

In 1951, Borberg[1] published a monumental study that began as a registry, for eugenic purposes, of all cases of tuberous sclerosis in Denmark, and which ended to include a detailed review, especially clinically, of that disease and the related von Recklinghausen's. Borberg examined 91 percent of 775 living members of 79 families that showed von Recklinghausen's disease. His is a most complete exposition of both diseases in all their many ramifications.

In Paris, in 1951, Offret[31] produced an exhaustive review of a slightly broader field, and in England, in 1949, Dresner and Montgomery[7] wrote upon primary optic atrophy in von Recklinghausen's disease, emphasizing the significance of atrophy in this condition and reporting three cases, two of them in identical twins. They made a sound review of the entire subject.

## Signs and symptoms

A primary optic-nerve tumor within the orbit commonly causes failing vision and exophthalmos. Less commonly there is restriction of ocular movements. The nerve-head usually shows atrophy, but sometimes papilledema. Visual and field changes without proptosis suggest intracranial or chiasmatic involvement, and enlargement of the optic foramen by radiography indicates that the tumor has extended into it.

Meningiomas generally involve ocular muscles before the optic nerve, while gliomas tend to do the opposite. Chiasmal tumors may occasionally produce symptoms of pressure and brain tumor. Usually the young patient has no symptoms other than reduced vision and some proptosis.

Optic-nerve gliomas are slow growing, and usually appear in the first or second decade. Both nerves may be involved independently. Meningiomas, as an optic-nerve tumor, are far less frequent than gliomas, occur at an older age, are nearly always intracranial, and are slow in causing loss of vision.

### Pathology

Grossly, glioma of the optic nerve appears as a fusiform enlargement beginning in the nerve about 10 mm. behind the globe and spreading backward, seldom forward.[82] Wolff believes this growth characteristic is due to the anatomy, the tumor being resisted by stronger septa anteriorly, and by the dura, which it may thin but seldom perforates. There is very little tendency for glioma, in contrast to meningioma, to invade non-neural tissues. Extension into the globe is uncommon.

Histologically, the tumors are similar to cerebral gliomas but with cellular differences difficult to interpret.[83] As analyzed by Davis,[3] there develops an abnormal proliferation of neuroglia in the nerve, which spreads through the pia to produce a tumor of the optic-nerve sheath, to which is added a proliferation of the mesothelial cells of the arachnoid. Davis divides the evolution of these growths into five stages. The predominant type of cell is the astrocyte.

Del Rio-Hortega links these tumors of the optic nerve and chiasm by histologic and morphologic similarities to many tumors of the corpus callosum and medulla, and to cerebellar astrocytoma. All have moderate malignancy.[82]

## Report of case

### History

A white girl, aged eight years, was first seen August 17, 1950, because her school nurse and her mother felt that her eyes looked abnormal. The right eye frequently had hordeoli, and about weekly she had a headache (fig. 1).

The child had never suffered injury or unusual illness. Birth and development had been normal. She was aware of poor vision in the right eye but no one knew the time or rapidity of its development.

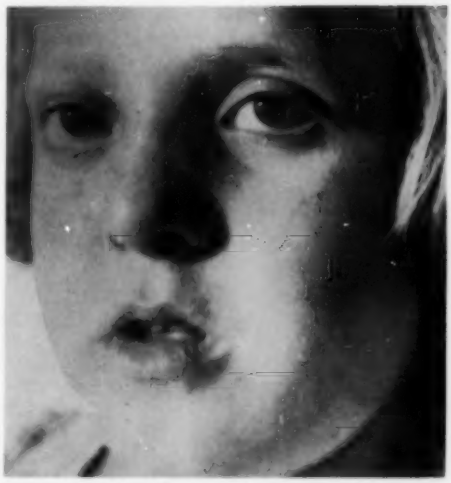

Fig. 1 (Marshall). Patient, aged eight years, preoperatively, showing six-mm. proptosis of right eyeball.

On the paternal side, the father and both his parents were living and well. The father had a congenital nevus, flat, soft, and brown, 20 by 12 mm., in his left groin. This had been present all his life and was unchanging. He had also a sebaceous cyst, eight mm. in diameter on the back of his neck, present all his life. Otherwise no physical abnormality was known in these paternal two generations.

On the maternal side, the mother, her sister, and her own mother, the patient's grandmother, all had café-au-lait spots. The grandmother additionally had multiple skin tumors and died of a rapidly growing sarcoma of the leg at the age of 48 years. The great-grandmother died a supposedly natural death. The great-grandfather died in 1904, and was reported to have had multiple skin tumors. The mother, in addition to 13 café-au-lait spots, had a plexiform neuroma over the right carotid, a painful neurofibroma left of the posterior midline over the tenth rib, several more in her scalp, and an incidental

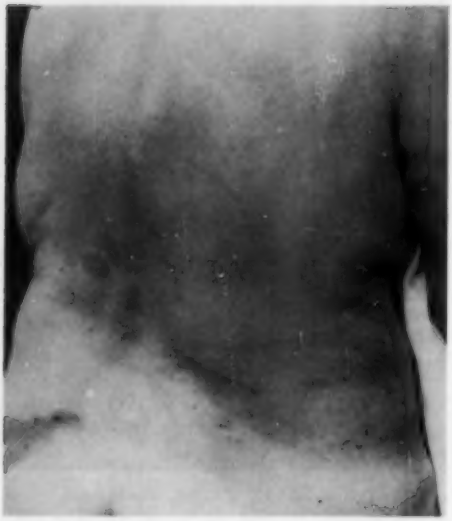

Fig. 2 (Marshall). Mother of patient, showing café-au-lait spots and nevus flammeus. A painful neurofibroma over the 10th rib left of the posterior midline was also present, and a plexiform neuroma over the right carotid.

nevus flammeus above the left buttock (fig. 2).

The patient was one of five offspring, three girls and two boys. One boy died at the age of 15 months, with autopsy which showed congenital patent foramen ovale, mitral insufficiency, and mitral vegetations. He had no known evidence of von Recklinghausen's disease. One sister, aged 18 years, was normal, married, and had two normal children. The remaining sister, aged 13 years, had, in 1953, 21 café-au-lait spots and two early neurofibromas (fig. 3). The brother, aged 11 years, had, in 1953, 16 café-au-lait spots, and three subcutaneous nodules (fig. 4). A biopsy of a supposed lymph gland in the epitrochlear region, performed on this boy in October, 1951, proved to be a "small neurofibroma showing degenerative changes." He was being studied at the time because of generalized lymphadenopathy, eventually diagnosed as being due to infectious mononucleosis.

A maternal aunt of the patient showed, in 1953, 15 café-au-lait spots, multiple areas of freckling, a very few cutaneous neurofibromas, and below the axilla on her right arm an oval tumor 10 by 4 cm., growing, quite hard, and possibly malignant.

She has four sons, who had respectively 32, 21, and 19 café-au-lait spots, and the fourth only one, on the left patella. Two of the boys had cutaneous and subcutaneous neurofibromas, and one had a mild kyphosis to clinical observation. Thus the mother and three of her four offspring showed unquestionable von Recklinghausen's disease. One son was considered to be normal at this time.

Figure 5 diagrams the inheritance of the disease in this family in four generations, the arrow designating the propositus or patient here reported.

## Examination

*Ocular examination.* Right visual acuity was moving objects, correctable under cycloplegia by +2.5 D. sph. to 20/200. Left vision was 20/25, not improved by retinoscopic correction of +0.25D. sph. $\bigcirc$ +1.25D. cyl. ax. 80°. Vertical width of palpebral fissures was: right, 10 mm.; left, 9.0 mm. Exophthalmometer measurement was: right, 19 mm.; left 13 mm. The eyes were straight and ocular move-

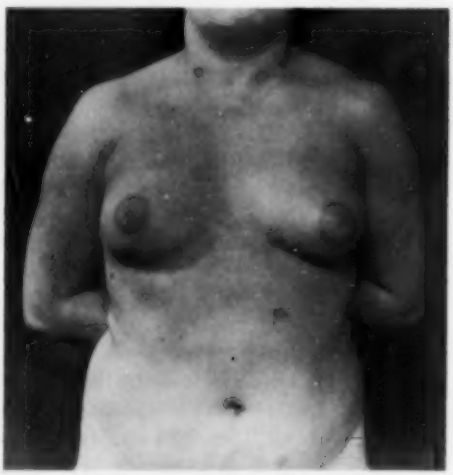

Fig. 3 (Marshall). Sister of patient in 1953, showing café-au-lait spots. She had a total of 21, and two early neurofibromas.

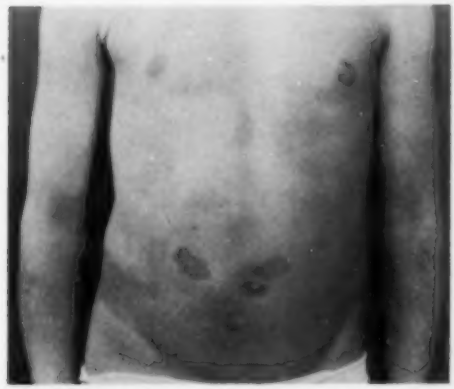

Fig. 4 (Marshall). Brother of patient in 1953, showing café-au-lait spots. He had 16 of these and three subcutaneous nodules.

ments full and normal.

The right pupil was fixed, and of five-mm. diameter; the left was smaller and active. Both were round.

Media of the right eye were clear. The disc showed two to four diopters of papilledema, and the retina adjacent to the disc below seemed farther anterior or forward than that above. There were no hemorrhages or exudates. The retinal veins were full, but not tortuous except at the disc, and the periphery of the fundus was normal.

The left fundus was normal. The disc had good color and small physiologic depression. Confrontation field of the left eye was normal.

*Diagnosis at first visit.* Tumor of the right orbit, probably of the optic nerve, with proptosis, papilledema, and great reduction in vision.

Further studies leading to surgery were advised. For these she was hospitalized from August 25 to 29, 1950. The following information was obtained.

*General physical examination.* An alert, oriented, co-operative girl with lisping speech. She showed good nutrition and color. Blood pressure was 94/60 mm. Hg. Skin showed patches of brownish pigmentation spotted over the body; these were large, discrete, and in the corium (fig. 6). Small discrete lymph nodes were palpable in the posterior-cervical, occipital, axillary, and inguinal regions. Tonsils were moderately large and somewhat injected. Nasopharynx was normal other than a moderate amount of adenoids. The nose was normal and without evidence of sinus disease. Ears were normal. There was an extensive alveolar abscess in the left upper jaw. Feet had unusually high arches.

*Neurologic examination.* All cranial nerves functioned normally except the right optic

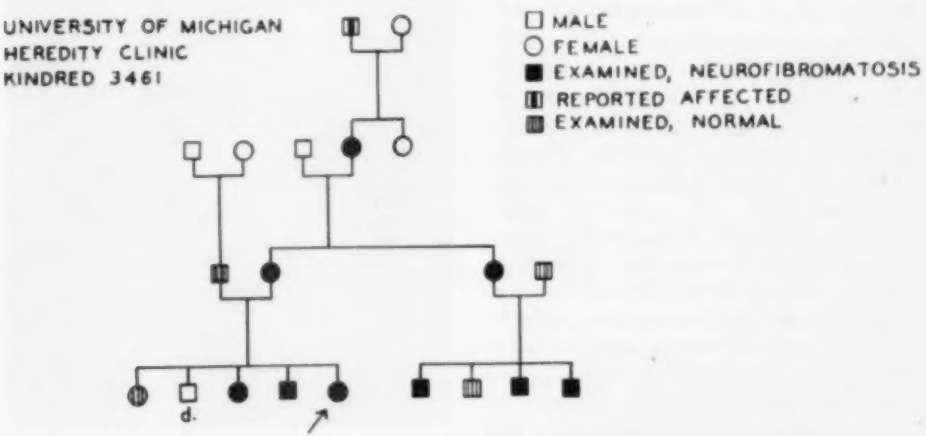


Fig. 5 (Marshall). Pedigree of patient (arrow) showing dominant inheritance of von Recklinghausen's disease in four generations. University of Michigan Heredity Clinic kindred 3461.

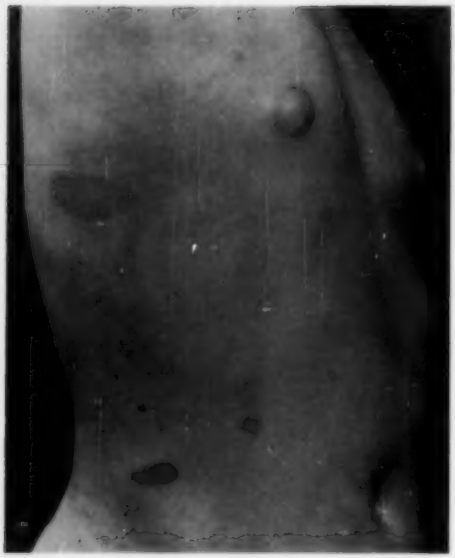

Fig. 6 (Marshall). Patient in 1953, two and one-half years after operation for glioma of right optic nerve. She had a total of 17 café-au-lait spots but no neurofibromas of the skin.

nerve. No abnormal reflexes were obtained. Sensorium was normal. Romberg and all cerebellar signs were negative or normal. Spinal fluid flowed slowly, was clear, with an initial pressure of 270 mm. $H_2O$ which rose to 340 mm. $H_2O$ on Quackenstead maneuver on either side, then receded to 280 mm. $H_2O$.

*Laboratory studies.* Blood: WBC, 5,700; RBC, 4,650,000; color index, 0.83; Schilling index, 0-0-5-54; monocytes, four percent; lymphocytes, 33 percent; eosinophils, four percent; neutrophils, 59 percent; hemoglobin, 12.1 gm.; standard Kahn reaction negative. Spinal fluid: Cell count, two; sugar, normal; total protein, 33 mg. percent. Urine: Normal; weakly positive test for melanin.

*X-ray studies.* Skull: Paranasal sinuses normal for age; no bone erosion; optic foramina of equal and normal size; slight soft tissue density of right orbit, but no destructive lesion. Chest and abdomen: Negative except for reversal of dorsal kyphosis, and mild scoliosis to right.

*Final preoperative diagnosis.* Orbital tumor, right, slow growing, affecting the optic nerve severely but the oculorotary muscles none. No neurologic or clinical evidence of metastasis or intracranial extension. Probably optic-nerve tumor; von Recklinghausen's disease.

SURGERY

The patient was hospitalized on September 4, 1950, for operation next day, and discharged home September 13, 1950.

*Operation.* Intratracheal ether was used. Krönlein exposure of orbit on lateral side was effected, using Stryker oscillating bone saw. After slitting the periorbita, a firm tumor was easily exposed deep in the orbital apex. It was a little bluish, with a bright smooth surface on which ran a vessel, and resembled a cyst. It was easily outlined except at the anterior end and at the hidden posterior end. A snap was placed on the anterior end which proved to be on the optic nerve at the globe. The nerve was cut behind this. Fairly normal nerve grossly was identified in this cut section.

Fig. 7 (Marshall). Patient two and one-half years after removal right optic-nerve glioma by Krönlein approach. Left eye normal.

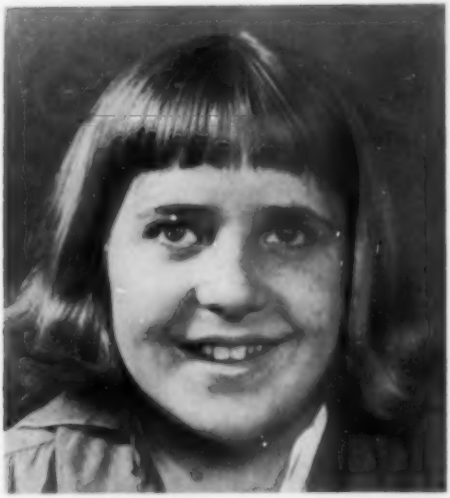

Fig. 8 (Marshall). Patient two and one-half years after operation. Ocular excursions were full and normal in all directions.

The tumor was now free except for firm attachments on its posterior side which could not be visualized. A tonsil snare was passed over the mass to the orbital apex and tightened; the tumor mass came out now clean and free and without bleeding.

Frozen section, run at once, showed "neuromyxoma encompassing the nerve."

Since, grossly, the anterior end was normal, the globe was not removed, and no more tissue could be removed from the apex of the orbit. The wound was closed without drain, but with lids united by a single suture. During the operation, which proceeded without difficulty or complication, the patient was given 500 ml. of whole blood and 500 ml. of glucose. Convalescence was smooth, and healing uncomplicated. There was transient mild edema of the operative site and bulbar conjunctiva, and ptosis of the upper lid. This all quickly disappeared.

### Postoperative course

*Fundus.* Right pupil remained fixed at 5.5 mm. diameter, and nearly round. Four days postoperatively there was a large white area of retinal edema in region of the optic disc. This gradually cleared but eight days postoperatively the area of the disc still was edematous and there were hemorrhages and edema at the macula.

Two weeks after surgery veins and arteries in the retina appeared to be almost the same in color, and both, except near the disc, showed segmentation and gaps in their blood column. Nasally and below, there was much atrophy and depigmentation of the retina. The macular area was still edematous. Some vessels appeared only as white strands.

Two and one-half years after surgery (fig. 7), the right lens and vitreous were clear. Disc markings were completely obliterated by an overlying white film of glial tissue. Most of the retina showed severe atrophy and pigment clumping but, from a point below the macula, the lower retina had a normal appearance except for extremely attenuated retinal vessels. The pupil was fixed at four mm. Ocular movements were full (fig. 8). Palpebral fissures measured: R.E., 9.0 mm.; L.E., 10 mm., in height. Exophthalmos measured: right, 16 mm.; left, 15 mm. The left eye had corrected vision of 20/15, J1 and its visual field was normal. Roentgenologic studies of the optic foramina showed them to be equal in diameter and unchanged from previous films.

### Pathologic report

*Gross.* The tumor specimen consisted of an ovoid, pinkish, smooth mass 2.0 by 1.5 by 1.2 cm. (figs. 9 and 10). The posterior end was 7.0 mm. across. Part of the tumor was sent to Dr. F. A. Davis, who made special stains and studies of it, and generously supplied the accompanying beautiful photomicrographs, and the following detailed histopathologic report:

### Histologic description of the tumor (Dr. F. A. Davis)

"A small piece of the optic nerve containing the tumor was sent to me for study. The specimen had been fixed in 10-percent formalin. At the Eye Pathology Laboratory of

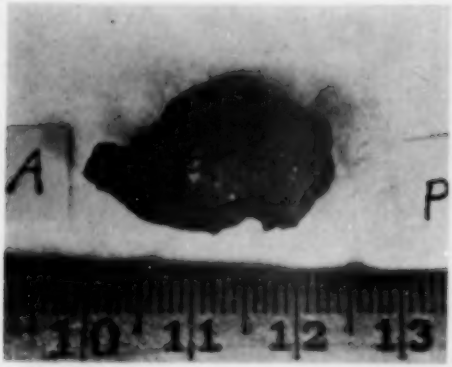


Fig. 9 (Marshall). Glioma of right optic nerve after excision. (A) is at anterior end. Size 2.0 by 1.5 by 1.2 cm.

the Wisconsin General Hospital, where my study was carried out, the specimen was refixed in formalin-ammonium bromide, and later run through various strengths of alcohol, with final embedding in celloidin. Some sections from a part of the tumor which were embedded in paraffin were obtained from Dr. Marshall. A number of staining methods were used, including hematoxylin-eosin, von Giesen, Mallory's phosphotungstic acid-hematoxylin, Weil-Davenport's modification of Hortega's silver carbonate stain, and Weigert-Pal.

"The sections, as mounted on slides, measured approximately 10 by 12 mm.

"The specimen, to gross inspection, showed the more solid central subpial nerve stem proper somewhat enlarged, measuring 5.0 by 6.0 mm. (figs. 11 and 12). Surrounding this a more loose-textured mass, which was described as soft and spongy in the fresh speci-

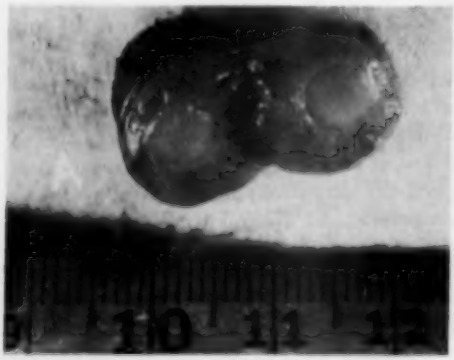


Fig. 10 (Marshall). Glioma of right optic nerve after excision, showing section cut at center. Nerve stem is surrounded by soft, subdural portion of the tumor.

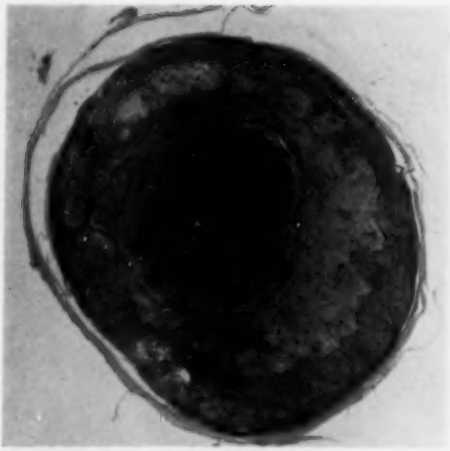

Fig. 11 (Marshall). Transverse section through tumor of nerve and sheath. Note subpial enlargement of nerve stem with invasion of the sheath by the tumor. (Low power. Hema' oxylin and eosin.)

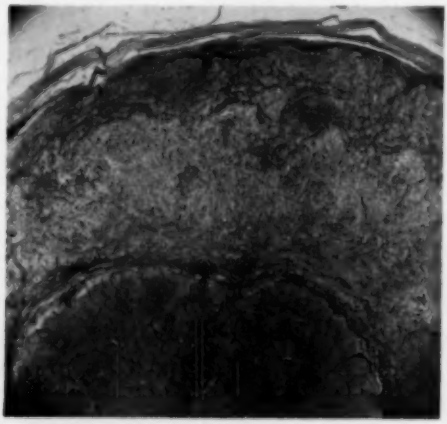

Fig. 12 (Marshall). Low-power view of tumor of nerve and sheath. Note glial tumor of sheath with layer of proliferated arachnoid cells beneath the thin dural sheath above. (Hematoxylin and eosin, ×50.)

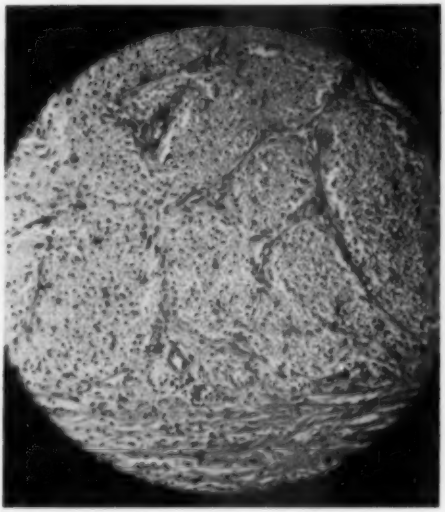

Fig. 13 (Marshall). Glioma of optic nerve and sheath. Transverse section through nerve stem. Note normal arrangement of funiculi and thickened septa due to condensation of glial fibers bordering septa. Pial sheath (bottom) thickened due to invasion of tumor and separation of lamellae. (Hematoxylin and eosin, ×150.)

men, filled the subdural and subarachnoid space.

"The central subpial portion of the nerve stem preserved the usual arrangement of the funiculi as seen in the normal optic nerve, except for their general increase in size due to the increase in the neuroglia within them. No optic-nerve fibers or myelin sheaths could be demonstrated. With ordinary hematoxylin-eosin stain (fig. 13) the funiculi were filled with innumerable nuclei of the glial cells. The fibrous septa preserved their normal arrangement, but appeared much thicker, chiefly due to a feltlike layer of glial fibers which ran along the inner border of the fibrous septa. Glial fibers were not as conspicuous as usually encountered in these tumors, probably due to the method of fixation. Blood vessels were inconspicuous and were seen only in the intraseptal spaces.

"The ground substances within the funiculi consisted of a vacuolated syncytium (fig. 14), demonstrable in thin sections, which

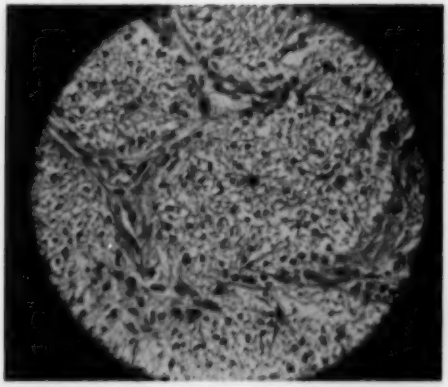

Fig. 14 (Marshall). High power of nerve stem showing vacuolated syncytium, or vacuolation of cells, and holes at former sites of nerve fibers.

with special differential stains, were identified as the processes of the glial cells, chiefly fibrous astrocytes and some oligodendrocytes similar to those encountered in the normal nerve (fig. 14a), though there were variations in the structure of the cells—some being much larger and the processes coarser than seen in the normal nerve. There were many

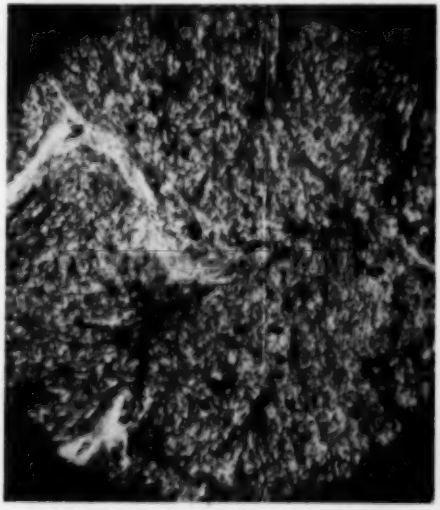

Fig. 14a (Marshall). Transverse section of nerve stem. Note astrocytes with long processes and some oligodendrocytes. (Weil-Davenport modification of Hortega's ammoniacal silver stain, ×500.)

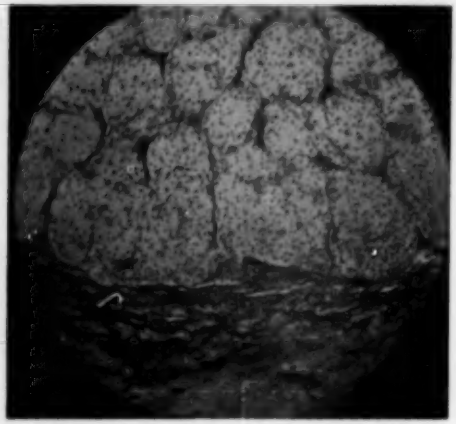

Fig. 15 (Marshall). Shows increased thickness of pial sheath due to invasion and separation of its fibrillas by the tumor (below). (Mallory's phosphotungstic stain, ×150.)

groups of large oval and multinucleated cells (fig. 13), but no mitotic figures were seen. These groups of large oval nuclei appeared to be due to amitotic division of the neoplastic astrocytes.

"The pial sheath (fig. 15) showed considerable increase in thickness, due to separation of the fibrillas because of invasion of this layer by the neoplastic cells. These were shown by differential stains to be glial cells which had invaded and broken up the pial sheath to form a part of the tumor of the sheath.

"The appearance of the sheath portion of the tumor (fig. 12) was quite different from that of the nerve stem proper, due in part to the difference in the structures invaded. Here the tumor was less compact, the general structure showing a coarser 'reticulated' arrangement of the cells, with many fine spaces—some filled with a faintly staining homogeneous fluid, probably serum. These coalesced occasionally in places, producing an appearance described by some as 'myxomatous.'

"The 'coarser reticulated' arrangement appeared to arise from the thick, wavy, sometimes curly, processes of the neoplastic astrocytes. These were clearly demonstrated with Hortega's silver carbonate stain. Typical oligodendroglial cells were also present, and some unipolar and bipolar cells, probably polar spongioblasts (fig. 16), were found, especially in the sheath tumor.

"Arachnoidal cells were interspersed among the glial cells, but for the most part were encountered on the outer border of the tumor as an irregular layer of cells beneath the dura (figs. 12 and 16).

"The sheath tumor was more vascular than that confined within the nerve stem, but blood vessels were relatively sparse.

"The dura was intact throughout, but was thinned out in some areas. It was not invaded by the tumor.

COMMENTS

(Dr. F. A. Davis)

"This tumor had the characteristic and typical appearance of other gliomas of the optic nerve which I have studied, and some of which have been previously reported.

"The tumor falls into the classification of

Fig. 16 (Marshall). Tumor of sheath. Upper center shows neoplastic astrocyte with long coarse processes. Two oligodendrocytes with short coarse processes lie above and below near the large astrocyte. Large bipolar cell (spongioblast?) left center. Nuclei of arachnoid cells poorly stained, scattered through field. (Weil-Davenport silver stain, ×350.)

Stage III according to the five topographic stages which I have described in my study of these tumors. This tumor shows many features which are almost identical with Case II previously described in the paper I published in 1940,[3] and the reader is referred to Figures 21, 22, 31, and 32 and the description of that tumor, in which the microscopic appearance closely resembles that of Dr. Marshall's case.

"These tumors do not arise from embryonic types of neural ectodermic cells as in some cerebral gliomas. They consist essentially of an abnormal proliferation of otherwise normal types of mature glial cells of the optic nerve, namely astrocytes and oligodendrocytes, and possibly microglia, though the latter cell type is difficult to identify in these lesions. Other atypical glial cells, such as unipolar and bipolar cells, are also present.

"The proliferation of the glial cells in the earliest stage of the growth (Stage I) is scarcely distinguishable from that of the normal nerve except for the great increase in number and early fiber formation. This stage might be more appropriately described as a gliomatosis, as suggested by Hudson. More recently, Bürki in his excellent monograph[8] has reverted to von Hippel's interpretation of these lesions, and suggests the descriptive term 'tumor-like fibro-gliomatosis.'

"In some instances the growths appear to become arrested in this earlier stage of gliomatosis.

"In the fully developed tumor the glial cells take on more active neoplastic characteristics, in which they show pleomorphism, hyperchromatism, and an obviously unnatural arrangement, and finally invade surrounding structures. I, therefore, feel they should then be more appropriately designated gliomas, type astrocytoma, Grade I to II."

## Management

A space-occupying lesion in the orbit may be not only a difficult problem in diagnosis,[61] but it has provoked much discussion on its management. We are considering here a primary tumor of the optic nerve. Glioma of the optic nerve is of low malignancy. On theoretical grounds, complete excision might be desirable, but recurrence after excision of the major portion is very uncommon. Since, in von Recklinghausen's disease, the glioma in the optic nerve may be only one of several sites of origin, conservative treatment is indicated, as emphasized by Davis 14 years ago.[2]

A glioma of the optic nerve may be intraorbital, or it may be intracranial and involve the chiasm. Its exact extent may be uncertain preoperatively.[62] Although there have been a few favorable reports following irradiation, control of the tumor depends basically on surgery.

Recent literature reveals disagreement on the best surgical approach.[63] If the tumor is intraorbital, the majority favors the anterior or lateral approach. If the optic foramen is enlarged or there is evidence of intracranial tumor, completely total extirpation is probably impossible or impractical, but if attempted it must be by the transcranial route. A few men advocate the transcranial approach even for a purely orbital tumor.[64]

To operate upon the chiasm is not only dangerous to the visual pathways but is often fatal because of damage to vital centers. To attempt to remove a glioma of the optic nerve in the short distance between foramen and chiasm, without endangering the chiasmal region, cannot effect a thoroughly complete excision, and therefore gains little.

The transcranial approach to an intracranial glioma of the optic nerve or chiasm becomes indicated, therefore, for diagnosis, or to unroof the optic canal, and to open the nerve sheaths and allow expansion. To attempt more, especially in the presence of von Recklinghausen's disease, would seem, usually, to be unwise.

Assuming that there is no clinical or radiographic evidence to indicate any involve-

ment of the optic nerve in the optic canal or cranial cavity, the points justifying and favoring an anterior or lateral surgical approach to the posterior orbit may be summarized as follows:

1. Simpler, safer, and adequate.[2, 5, 61, 65–67]

2. Better exposure of the tumor; it may be missed by transcranial approach.[68–70]

3. Since recurrence is rare, removal of the major portion of a glioma of the optic nerve is sufficient.[5]

4. It is not necessary to remove the globe.

Advocates of the transcranial approach to optic-nerve tumors have presented the reasons below:

1. There is always the possibility of intracranial involvement.[71, 72, 77]

2. Some claim that exposure of an orbital tumor is better.[63, 73]

3. Hemorrhage is more easily controlled.[74, 75]

4. Complete removal of the tumor offers the best prognosis.[73, 76]

5. The low degree of risk today.[78–80]

6. Impossible to be certain whether all of the tumor has been excised from the orbit, by anterior approach.[72]

7. May avoid sacrifice of a useful globe.[81]

Most of these dicta have been presented without von Recklinghausen's disease in mind. If the systemic nature of that disease is recognized and the place of optic-nerve glioma in it, the advantage of the anterior or lateral approach to the orbit will be acknowledged on the grounds of safety and adequacy, while the transcranial approach will be reserved for purposes of diagnosis and decompression.

And since a glioma of the optic nerve or chiasm is often only part of a systemic disease, and is usually so in the first two decades, a patient with this lesion should be routinely subjected to a careful search for other manifestations of von Recklinghausen's disease. We should look for the forest, not just at the tree.

Once again we must seek to have the viewpoint of the physician first, the ophthalmologist second. More plainly, as expressed by Trueblood,[55] "In order that the physician discover every case of von Recklinghausen's disease which comes to his practice, it is necessary that each patient be completely undressed."

Dr. F. A. Davis has alone found 15 instances of glioma with von Recklinghausen's disease, several of them previously missed by a variety of experts.[101] There can no longer be doubt that the frequency of this tumor association far exceeds the reported instances.

## Summary

Von Recklinghausen's neurofibromatosis, a hereditary disease of protean manifestations, may be evident as a glioma of the optic nerve or chiasm. Such a tumor is discussed from the clinical and surgical viewpoint. A case is reported of a young girl who had glioma of the optic nerve, with undoubted evidences of von Recklinghausen's disease in herself, in most of her near relatives, and in four generations. The frequent association of this tumor with von Recklinghausen's disease is emphasized.

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## References

1. Borberg, A.: Clinical and genetic investigations into tuberous sclerosis and Recklinghausen's neurofibromatosis. Acta psychiat. & neurol., Suppl. No. 71, pp. 1-239, 1951.

2. Gomes, J. P.: Tumors of the optic nerve. (Discussion by F. A. Davis.) Am. J. Ophth., **24**:1144-1169 (Oct.) 1941.

3. Davis, F. A.: Primary tumors of the optic nerve (a phenomenon of Recklinghausen's disease). Arch. Ophth., **23**:735 (Apr.); 957 (May) 1940.

4. ———: Plexiform neurofibromatosis of orbit and globe, with associated glioma of the optic nerve and brain. (Discussion by F. H. Verhoeff.) Arch. Ophth., **22**:761-791 (Nov.) 1939.

5. Reese, A. B.: Tumors of the Eye. New York, Hoeber, 1951, p. 150.

6. Sommers, I. G.: Histology and Histopathology of the Eye. New York, Grune & Stratton, 1949, p. 412.

7. Dresner, E., and Montgomery, D. A. D.: Primary optic atrophy in von Recklinghausen's disease. Quart. J. Med., **18**:93-103 (Apr.) 1949.

8. Bürki, E.: Ueber den primären Sehnerventumor und seine Beziehungen zur Recklinghausenschen Neurofibromatose. Bibliotheca Ophthalmologica, Fasc. 30, p. 3-64, 1944.

9. Am. Acad. Ophth.: Ophthalmic Pathology. Philadelphia, Saunders, 1952, p. 416.

10. Christensen, E., and Andersen, S. R.: Primary tumors of the optic nerve and chiasm. Acta Psychiat. & Neurol. Scand., **27**:5-16, 1952.

11. Offret, G.: Les tumeurs primitives de l'orbite. Soc. franç. d'ophtal., Paris, Masson, 1951.

12. Lichtenstein, B. W.: Neurofibromatosis: Analysis of the total pathologic picture. Arch. Neurol. & Psychiat., **62**:822-839 (Dec.) 1949.

13. Rayer (1835): Cited by Grön, K.: Forme fruste of von Recklinghausen's disease. Brit. J. Dermat., **35**:364, 1923.

14. von Recklinghausen, F.: Ueber die multiplen Fibrome der Haut und ihre Beziehung zu den multiplen Neuromen. Berlin, A. Hirschwald, 1882.

15. Kirby, T. J.: Ocular phakomatoses. Am. J. M. Sc., **222**:227-239 (Aug.) 1951.

16. Bloch, F. J.: Retinal tumor associated with neurofibromatosis. Arch. Ophth., **40**:433-437 (Oct.) 1948.

17. Scott, B. E., and Cohen, H. J.: Neurofibromatosis in a newborn infant. Am. J. Dis. Child., **82**:574-578 (Nov.) 1951.

18. Prendergast, J. J.: Congenital tactile corpuscle neuroma of the orbit and antrum. Tr. Pac. Coast Oto.-Ophth. Soc., 1950, p. 117.

19. Holt, J. F.: Osseous manifestations of neurofibromatosis. Proc. New England Roentgen Ray Soc., **6**:57-67 (Feb.) 1950.

20. Crowe, F. W., and Schull, W. J.: The diagnostic importance of the café-au-lait spot in neurofibromatosis. Arch. Int. Med., **91**:758-766 (June) 1953.

21. Thannhauser, S. J.: Neurofibromatosis and osteitis fibrosa cystica localisata et disseminata. Medicine, **23**:105-149 (May) 1944.

22. Grill, J., and Kuzma, J. F.: Case report: Recklinghausen's disease with unusual symptoms from intestinal neurofibroma. Arch. Path., **34**:902-910, 1942.

23. Schick, B.: A case of neurofibromatosis in a child. J. Mt. Sinai Hosp., **10**:399-401 (Sept.-Oct.) 1943.

24. Wallach, E. A.: A case of multiple neurofibromatosis with some unusual features. Am. J. Ophth., **31**:1487-1489 (Nov.) 1948.

25. Cooperstock, M.: Congenital enlargement of the extremities. Am. J. Dis. Child., **57**:309-321 (Feb.) 1939.

26. Friedman, M. M.: Neurofibromatosis of bone. Am. J. Roentgenol., **51**:623-630 (May) 1944.

27. Heublein, G. W., Pendergrass, E. P., and Widmann, B. P.: Roentgenographic findings in the neurocutaneous syndromes. Radiology, **35**:701-727 (Dec.) 1940.

28. McCarroll, H. R.: Clinical manifestations of congenital neurofibromatosis. J. Bone & Joint Surg., **32-A** (No. 3): 601-617 (July) 1950.

29. Barber, C. G.: Congenital bowing and pseudarthrosis of the lower leg. Surg., Gynec. & Obst., **69**: 618-626 (Nov.) 1939.

30. Fairbank, H. A. T.: From an atlas of general affections of the skeleton: neurofibromatosis. J. Bone & Joint Surg., **32-B** (No. 2): 266-270 (May) 1950.

31. Stillman, F. S.: Neurofibromatosis. J. Oral Surg., **10**:112-117 (Apr.) 1952.

32. Vogt, L. G.: Pulsierender Exophthalmus und neurofibromatose Recklinghausen. Zentralbl. Neurochir., **11**:112-116, 1951.

33. Peyton, W. T., and Simmons, D. R.: Neurofibromatosis with defect in wall of orbit. Arch. Neurol. & Psychiat., **55**:248-265 (Mar.) 1946.

34. Schöpe, M.: Zur pathogenese des meningioms und des zentralen neurinoms bei der von Recklinghausenschen Krankheit. Archiv. f. Psych. u. Ztschr. Neurol., **186**:603-622, 1951.

35. Woodhall, J. P., and Echols, D. H.: Multiple operative procedures in a case of von Recklinghausen's disease. New Orleans M. & Surg. J., **99**:507-510 (Apr.) 1947.

36. Quinland, W. S.: Multiple tumors of different types in the same individual. J. Nat. M. A., **42**:14-20 (Jan.) 1950.

37. Oravisto, T.: On neurofibromatosis in the region of the eye. Acta ophth., **27**:89-98, 1949.

38. Merke, von F.: Rezidivierende neurofibromatose der orbita. Helvet. med. acta, **6**:900-907 (Mar.) 1940.

39. Robson, S., Blackwood, W., and Cookson, H. A.: A case of von Recklinghausen's disease with diffuse neurofibromatosis of the choroid. Brit. J. Ophth., **25**:431-442 (Sept.) 1941.

40. Allende, F. P.: Diffuse neurofibromatosis involving the bulbar conjunctiva. Arch. Ophth., **33**:110-115 (Feb.) 1945.

41. Herndon, C. N., and Dudley, F. C.: The inheritance of von Recklinghausen's neurofibromatosis. J. Bowman Gray School Med., **1**:69-74 (May) 1943.
42. Crowe, F. W.: Personal communication.
43. Tanner, J. W., and Hertzog, A. J.: Fibrosarcoma of the optic nerve, Wisconsin M. J., **39**:29-30 (Jan.) 1940.
44. Loftis, E. L.: Recklinghausen's disease in identical twins. Arch. Dermat. & Syph., **42**:657 (Oct.) 1940.
45. Gardner, W. J., and Turner, O.: Bilateral acoustic neurofibromas. Arch. Neurol. & Psychiat., **44**: 76-99 (July) 1940.
46. Gartner, S.: Malignant melanoma of the choroid and von Recklinghausen's disease. Am. J. Ophth., **23**:73-78 (Jan.) 1940.
47. Strakhov, V. P., and Shepkalova, V. M.: Recklinghausen's disease, neurinoma right orbit and melanosarcoma left choroid, Vestnik. oftal., **18**:12-16, 1941. (Abstract: Ophthalmology in the War Years. 1946, v. 1, p. 1078.)
48. Benedek, L., and Juba, A.: Meningeomatose bei der Recklinghausenschen Krankheit, Monatschr. f. Psychiat. & Neurol., **108**:157-166, 1943.
49. Pagès, P., Lafon, R., Gros, C. and Minvielle, J.: Formes centrales (cérébrale et médullaire) de la maladie de Recklinghausen. Rev. Neurol. (Paris), **83**:483-491 (Nov.) 1950.
50. Levin, O. L., and Behrman, H. T.: Recklinghausen's disease. Arch. Dermat. & Syph., **41**:480-502 (Mar.) 1940.
51. Herrmann, J.: Sarcomatous transformation in multiple neurofibromatosis. Ann. Surg., **131**:206-217 (Feb.) 1950.
52. Harvey, E.: Neurofibromatosis occurring in three consecutive generations. Arch. Ophth., **35**:700-703 (June) 1946.
53. Maksim, G., Henthorne, J. C., and Allebach, H. K.: Neurofibromatosis with malignant thoracic tumor and metastasis in a child. Am. J. Dis. Child., **57**:381-390 (Feb.) 1939.
54. Charache, H.: Multiple neurofibroma with sarcomatous transformation and skeletal involvement. Arch. Dermat. & Syph., **40**:185-191 (Aug.) 1939.
55. Trueblood, D.: Clinical significance of neurofibromatosis. West. J. Surg., **48**:134-145 (Mar.) 1940.
56. Williamson Noble, F. A.: Doyne Memorial Lecture: The ocular consequences of certain chiasmal lesions. Tr. Ophth. Soc. U. Kingdom, **59**:627, 1939, Part 2.
57. Goldsmith, J.: Neurofibromatosis associated with tumors of the optic papilla. Arch. Ophth., **41**:718-729 (June) 1949.
58. White, J. P., and Loewenstein, A.: An unpigmented primary tumor of the optic disc. Brit. J. Ophth., **30**:253-260 (May) 1946.
59. Pitter, J., and Vrahec, F.: Interesting case of tumour of the optic disc and the optic nerve. Čsl. Ofthal., **7**:187-192, 1951.
60. Sillevis Smit, W. G.: Neurofibromatosis of the face with deformities of the skeleton, Ned. Tijdschr. Geneesk., **4/40**:2888-2894, 1950.
61. Forbes, S. B.: Exophthalmos in relation to orbital tumors. (Discussion by B. Anderson.) Southern M. J., **40**:206-213 (Mar.) 1947.
62. Editorial: Surgical exploration of the orbit. Brit. M. J., **1**:419 (Mar.) 1947.
63. Benedict, W. L.: Surgical treatment of tumors and cysts of the orbit. Am. J. Ophth., **32**:763-773 (June) 1949.
64. Fralick, F. B.: The orbit: Annual review. Arch. Ophth., **44**:437-453 (Sept.) 1950.
65. O'Brien, C. S.: Ocular surgery. Arch. Ophth., **37**:1-8 (Jan.) 1947.
66. Wright, A. D.: Approach to orbital tumors. Tr. Ophth. Soc. U. Kingdom, **68**:367-375, 1949.
67. Summerskill, W. H.: The exploration of the orbit. Brit. J. Ophth., **34**:292-302 (May) 1950.
68. Stallard, H. B.: A plea for lateral orbitotomy (Krönlein's operation). Brit. M. J., **1**:408-409 (Mar.) 1947.
69. Horns, R. C.: Primary tumors of the optic nerve. Minn. Med., **33**:241-243; 304 (Mar.) 1950.
70. Drell, M.: Orbital neoplasm. Am. J. Ophth., **27**:543 (May) 1944.
71. Love, J. G., and Benedict, W. L.: Transcranial removal of intraorbital tumors. J.A.M.A., **129**:777-784 (Nov.) 1945.
72. Bucy, P. C., Russell, J. R., and Whitsell, F. M.: Surgical treatment of tumors of the optic nerve. Arch. Ophth., **44**:411-418 (Sept.) 1950.
73. Benedict, W. L.: Diseases of the orbit. Am. J. Ophth., **33**:1-10 (Jan.) 1950.
74. Tönnis, W.: Die operative Behandlung der das Foramen opticum überschreitenden Geschwülste des N. Opticus. Acta Neurochir., **1**:52-71, 1950.
75. Love, J. G.: Transcranial removal of intraorbital tumors. Proc. Staff Meet. Mayo Clinic, **16**:409-410 (June) 1941.
76. Rand, C. W., Irvine, R., and Reeves, D. L.: Primary glioma of the optic nerve. Arch. Ophth., **21**: 799-816 (May) 1939.

77. Dandy, W. E.: Results following the transcranial operative attack on orbital tumors. Arch. Ophth., **25**:191-216 (Feb.) 1941.
78. Posner, M., and Horrax, G.: Tumors of the optic nerve. Arch. Ophth., **40**:56-76 (July) 1948.
79. Mitchell, R. M.: Glioma of the optic nerve. New Zealand M. J., **49**:686-688 (Dec.) 1950.
80. Buffat, J. D.: Le traitement neurochirurgical des tumeurs du nerf optique. Rev. méd. Suisse Romande, **69**:511-522 (Aug.) 1949.
81. Craig, W. McK., and Gogela, L. J.: Intraorbital meningiomas. Am. J. Ophth., **32**:1663-1680 (Dec.) 1949.
82. Wolff, E.: Discussion on tumors of the optic nerve. Proc. Roy. Soc. Med., **33**:687-688 (Aug.) 1940.
83. del Rio-Hortega: Ibid., pp. 686-687.
84. Brinton, D.: Bilateral primary optic atrophy from glioma of the optic nerves. Proc. Roy. Soc. Med., **30**:855-856, 1937.
85. Schmidt, M.: Vorweisung zur Krankheitsgruppe der Phakomatosen. Klin. Monatsbl. f. Augenh., **102**:286-287, 1939.
86. Schneider, Paul: Diss. Frankfurt, 1940. Quoted by Bürki.[8]
87. Goldmann, H., and Grünthal, E.: Ueber einen Tumor des Sehnerven und seiner Leptomeningen bei Recklinghausenscher Krankheit. Ophthalmologica, **102**:79-92 (Aug.) 1941.
88. Pfeiffer, R. L.: Roentgenography of exophthalmos with notes on the roentgen ray in ophthalmology. Am. J. Ophth., **26**:724-741; 816-833; 928-942, 1943.
89. Rettelbach, E., and Schutzbach: Ueber Sehnerventumoren, ihre Beziehungen zur Neurofibromatosis Recklinghausen und ihre klinisches Krankheitsbild. Arch. f. Ophth., **145**:179-241, 1942.
90. Braendenstrup, P.: Primary tumors in the optic nerve. Acta ophth., **22**:72-94, 1944.
91. Pugh, R. J.: Tumour of the optic chiasm and nerve sheaths. Proc. Roy. Soc. Med., **39**:695-696 (Sept.) 1946.
92. Granroth, T.: A case of von Recklinghausen's neurofibromatosis. Acta dermato-venereol., **26**:321-328, 1946.
93. Meadows, S. P.: Quoted by Dresner and Montgomery[1] as personal communication.
94. Löhlein, W., and Tönnis, W.: Die operative Behandlung der das Foramen opticum uberschreitenden Sehnervengeschwülste. Arch. f. Ophth., **149**:318-354, 1949.
95. Paufique, L., and Etienne, R.: Gliome et pseudogliome du chiasma. Ophthalmologica, **117**:90-103, 1949.
96. Godtfredsen, E.: Studies on orbital tumors. Acta ophth., **25**:279-310, 1947.
97. Bodechtel, G.: Zur Klinik der zentralen Formen der Neurofibromatose (Recklinghausen). Arch. f. Psychiat. u. Ztschr. Neurol., **185**:326-344, 1950.
98. Cohen, I.: Tumors of the intracranial portion of the optic nerve. J. Mt. Sinai Hosp., **17**:738-745 (Mar.-Apr.) 1951.
99. Paillas, J. E., Guillot, P., and Bonnal, J.: Tumeurs du chiasma. Presse méd. (Paris), **59**:625-627, 1951.
100. Mecca, M.: A tumor of the optic nerve and Recklinghausen's disease. Ann. di ottal. e clin. ocul., **78**:61-76 (Jan.) 1952.
101. Davis, F. A.: Personal communication.
102. Weigelin, S.: Arch. Ophth., **13**:914-915 (May) 1935; Klin. Monatsbl. f. Augenh., **94**:106, 1935.
103. Beck, E.: Zwei Fälle von Neurofibromatose mit Befallensein des Zentralnervensystems. Ztschr. f. d. ges. Neurol. u. Psychiat., **164**:748-789, 1939.
104. Meyer, F. W.: Recklinghausensche Neurofibromatose und Auge. Klin. Monatsbl. f. Augenh., **103**:44-53 (July) 1939.
105. Wiegmann: Ein Fall von Recklinghausenscher Krankheit mit Komplikationem von seiten der Augen. Klin. Monatsbl. f. Augenh., **68**:395, 1922.
106. Reverdin, A., and Grumbach: Un cas de neurinome du nerf optique. Ann. d'anat. pathol. med.—chir., **2**:229-237 (May) 1925.

## Discussion

Dr. Frederick A. Davis, Madison, Wisconsin: Dr. Marshall's paper is a most valuable contribution. His interesting case report and thorough review of the recent literature serve to re-emphasize the relationship of glioma of the optic nerve and von Recklinghausen's disease which, as he points out, has been generally overlooked or disregarded by most American authors. His study should aid in firmly establishing the fact that gliomatous lesions of the optic nerve and chiasm are in a very high percentage of cases but a manifestation or phenomenon of this disease.

His review of von Recklinghausen's disease is worthy of study by ophthalmologists, general physicians, and neurologists alike. He emphasizes that the disease is basically neurogenic, "uniting a multitude of tumors under one roof." It probably arises from some aberration in the germ plasm which primarily affects neural ectoderm.

The great variety of tumors which may develop

in von Recklinghausen's disease depends upon the site of the lesions. All, no doubt, have a common neurogenic background. The growths may logically be considered to be secondary to a primary lesion in the neuron or its neurites which leads to a proliferation or tumefaction of the supportive structures of nervous tissue.

A patchy or spotty degeneration of the neural elements may upset the orderly development of adjacent supportive structures, or it may liberate certain "stimulating" biochemical products, as Verhoeff suggested long ago, which lead to proliferation or tumefaction of these supportive structures, be it neuroglia, the meninges, the endo- or peri-neurium, or the sheath of Schwann.

The earliest manifestations are the café-au-lait spots, still frequently unrecognized or ignored. These insignificant sign posts may point to serious involvement of the central nervous system, especially the optic nerve or chiasm. Both may be congenital or may appear during the first decade of life.

The presence of the full-blown tumor with proptosis is no longer necessary for diagnosis of glioma of the optic nerve or chiasm. Ophthalmologists should recognize that reduction of vision and optic atrophy alone may be sufficient for diagnosis, especially in a child, *if* the telltale café-au-lait spots or other cutaneous manifestations of von Recklinghausen's disease are present in the patient or members of the family. Enlargement of the optic foramina would supply additional and conclusive evidence of an optic-nerve lesion.

These lesions are of low-grade malignancy, usually slow growing. Some appear to become arrested spontaneously.

Since publication of my study of these tumors 14 years ago, I have studied 10 additional cases, making a total of 15. In *all* of these cases, glial lesions of the optic nerve and/or chiasm were accompanied by peripheral signs of von Recklinghausen's disease, usually of the abortive type.

When the lesion is confined chiefly to the orbit, I endorse the anterior orbital operative approach. It has been proven adequate in most cases. It is simpler and safer than the transcranial route. The latter is valuable for other tumors lying deep in the orbit, and it is indicated at times for diagnosis, or unroofing of the optic canals.

The chiasmal lesion is inoperable, and mortality is high if operation is attempted. Multiple areas of glial hyperplasia may exist in other areas of the central nervous system, so complete eradication of the neoplasm is generally impossible.

Deep X-ray therapy offers hope of limiting or arresting the lesion, especially when the chiasm is involved.

I believe, with the evidence now available, the term "von Recklinghausen glioma of the optic nerve and chiasm" should be adopted to designate specifically the glioma which is part of this syndrome.

It would appear that most, if not all, gliomas of the optic nerve which develop during the first or second decade of life belong to this syndrome. Burden of proof to the contrary must rest upon demonstration that no taint of von Recklinghausen's disease is present in the patient or the kindred.

Dr. Marshall's statement, "once again we must seek to have the viewpoint of the physician first, the ophthalmologist second," is timely. Too many ophthalmologists have been satisfied with a laboratory diagnosis of optic-nerve tumors, with inadequate personal study of the patient, particularly inspection of his body.

I will now show a few slides illustrating different types of gliomatous lesions of the optic nerve and chiasm in four of my more recent unreported cases.

Slide 1 illustrates the typical advanced glioma with marked proptosis of the globe. The lesion was confined to the orbital portion of the nerve, which was excised, together with the globe, by the anterior orbital approach which I have previously described.

Slide 2 illustrates a gliomatous involvement confined chiefly to the posterior ends of both optic nerves. Transcranial exploration with unroofing of the optic canals was performed in the Neurosurgical Department of the Wisconsin General Hospital, with improvement in vision and expansion of the field in one eye; the patient has retained useful vision for about 10 years.

Slide 3 illustrates a glioma of the chiasm in a little girl, aged four years, who was virtually blind when first seen by me. Right frontal craniotomy and biopsy of the lesion by Dr. Otanesek confirmed my diagnosis of von Recklinghausen glioma (astrocytoma.) The presence of insignificant café-au-lait spots in the skin and a bilateral optic atrophy were sufficient to establish a definite clinical diagnosis of glioma of the chiasm.

Slide 4, an infant, aged 10 months, had a glioma of the posterior end of the left optic nerve and other manifestations of von Recklinghausen's disease, including neurofibromatosis of the left iris, with a distorted pupil, and a thickening of the left upper lid, probably due to early neurofibromatosis. Typical café-au-lait cutaneous pigmented spots were present in all of these cases.

Dr. Algernon B. Reese, New York: I think Dr. Marshall has called our attention to a most important relationship. As he said, Dr. Frederick A. Davis consolidated the subject in his excellent monograph which was awarded the Knapp Medal. I want to emphasize the point that von Recklinghausen's disease in the young manifests itself usually in a subtle fashion. More often than not it is in the form of some skin change which may be in the nature of an elephantiasis neuromatosa, or café-au-lait pigmentation. I would like to cite five instances in which an awareness of the relationship in von Recklinghausen's disease has been of help to me.

The following five cases were then briefly mentioned with pertinent illustrations.

Case 1. A young boy with unilateral exophthalmos and a skin lesion in the scalp of the elephantiasis neuromatosa type. Glioma of the optic nerve was confirmed by operation.

Case 2. A young girl with unilateral exophthal-

mos, café-au-lait pigmentation of the skin, and scoliosis. Glioma of the optic nerve was confirmed by surgery.

Case 3. A young girl with unilateral exophthalmos, and an area of elephantiasis neuromatosa of the skin of the thigh. Glioma of the optic nerve was proven.

Case 4. A young girl with unilateral exophthalmos, and skin changes on the back. X-ray studies showed a bony defect in the lateral wall of the orbit. This proved to be neurofibromatosis of the orbit with extension to the anterior cranial fossa. This case points up the fact that the exophthalmos in these cases may be due to orbital neurofibromatosis as well as to glioma of the optic nerve.

Case 5. An adult with papilledema of both eyes, multiple pedunculated neurofibromas of the skin, proved histologically, and deafness on the left side. This patient proved to have a neuroma of the acoustic nerve, the commonest nerve involved in neurofibromatosis.

I should like to compliment Dr. Marshall on his excellent paper and also to pay my respects to Dr. Davis for his outstanding contribution on this subject.

Dr. Harold F. Falls, Ann Arbor, Michigan: I should like to congratulate Dr. Marshall on his excellent presentation of a most timely subject. His paper supplements a definite trend, evidenced during the past decade, for the specialist to exhibit increasing interest in disease entities which affect the entire constitution.

Von Recklinghausen's disease (neurofibromatosis), most certainly one of the constitutional diseases, presents an extreme protean range of expressivity. The alert ophthalmologist, thoroughly acquainted with the various forms of neurofibromatosis, can be of diagnostic service to his colleagues in other branches of medicine. As an example, it was recently possible to diagnose clinically a tumor of the tongue in an infant largely because of previous experience with the child's affected mother who presented bilateral orbital neurofibromatosis.

The hereditary nature of neurofibromatosis should always be kept uppermost in the mind of the physician. Dr. Marshall's pedigree which presents an autosomal dominant inheritance pattern is representative of the accepted transmission mode of the disease entity. *Forme fruste*, or abortive mild forms of expression of the disease exhibited by the affected patient, implies that his or her germ plasm contains the noxious gene and can therefore be transmitted to successive generations, often presenting extensive constitutional manifestation. Leiomyoma, hypernephroma, and rhabdomyoma are tumors which, when present, should stimulate the physician to consider the presence of neurofibromatosis.

In a recent study by Crowe and Schull, of the University of Michigan Heredity Clinic, of 100 cases of neurofibromatosis in Michigan families, it was suggested that the disease could be diagnosed by the presence of café-au-lait spots. These authors concluded that in a sporadic case six café-au-lait spots each at least 15 millimeters in diameter could be considered diagnostic of neurofibromatosis. The number of café-au-lait spots necessary for diagnosis of neurofibromatosis drop with the awareness of affected parents or siblings.

We may thus conclude that neurofibromatosis is a constitutional disease and, as physicians, we must possess an acute awareness of its protean nature.

Dr. F. H. Verhoeff, Boston, Massachusetts: I think Dr. Marshall has made a very important contribution, and has thoroughly established the fact that glioma of the optic nerve is a part of von Recklinghausen's disease, as maintained by Dr. Davis. In 1921, I read a paper on glioma of the optic nerve before the A.M.A. Section, and I was given the Knapp Medal for that. In 1939, Dr. Davis presented a paper on this subject before the same section, and I suppose a good many people thought I ought to have transferred my medal to him, but it happened that I was chairman of the committee awarding the medal, and so instead of transferring my medal, I gave him a brand new one.

If I could refute Dr. Davis' contention I would be glad to do so, but I have no evidence to use against it. It is unfortunate, even if we accept this view, that we can do very little about the matter, no more than we can do about the weather, but it is important from the standpoint of diagnosis.

There are two relatively trivial things which interest me greatly in the study of these tumors:

1. The frequent occurrence of cytoid bodies in them. This fact absolutely eliminates the old explanation that they are varicose nerve fibers. I thought they represented a peculiar transformation of the blood which was in the neuroglia syncytium. Up to now I have not seen any reason to change that view. Some of these tumors are loaded with cytoid bodies.

2. The other thing that especially interests me is the occurrence in these tumors of cavernous spaces such as we see in cavernous atrophy of the optic nerve. This raises the question as to just how the spaces are produced.

Dr. A. Franceschetti, Geneva, Switzerland: I think the discussion has shown the importance of the question of von Recklinghausen's disease in the paper of Dr. Marshall. As he explained very ably the general symptoms and the eye symptoms, I will only add one word about the eye symptoms concerning heterochromia. I know neuromas of the eyes were mentioned, but I think the cases are not so rare in which we find heterochromia, pigmentation of one eye without other lesions of the eye, and I think when we see heterochromia we must think of von Recklinghausen's disease. Lastly, I would add that sometimes we have in these cases a displaced pupil, or we may also have an

ectropion. I think especially with heterochromia we must always think of von Recklinghausen's disease, and that should be added to the very complete table that was shown.

DR. DON MARSHALL (closing). I can add nothing more to the very valuable and interesting discussion that has been given by these various speakers. We all recognize that few people, if any, know more about von Recklinghausen's disease as it is related to the eye than Dr. Davis, and I want to express my sincere appreciation to him for guiding me in this report.

As has been stated most ably by Dr. Reese and Dr. Falls, we are dealing with a constitutional disease. Many of us were once taught, when considering a diagnosis, always to remember syphilis and multiple sclerosis, no matter where in the body the signs and symptoms may arise. We must also consider von Recklinghausen's disease as one which may manifest itself in any system, in any part of the body, and in any specialty including ophthalmology.

In the full paper, reference is made to the work of the University of Michigan Heredity Clinic, and to their first paper[29] on café-au-lait spots and their relation to von Recklinghausen's disease. Dr. Crowe assisted me in investigating more fully this disease among the kindred of my patient.

I feel honored that Dr. Verhoeff and Dr. Franceschetti should discuss this paper, and am very appreciative of the kind consideration they have given.

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# PRIMARY OPTIC ATROPHY IN VON RECKLINGHAUSEN'S DISEASE

## REPORT OF A CASE

WILLIAM A. MILLER, M.D., AND WILLIAM VAN HERICK,* M.D.
*Seattle, Washington*

In 1882, von Recklinghausen described a type of multiple tumor syndrome and disease of congenital origin characterized by cutaneous pigmentation and multiple tumors of the skin, cranial and peripheral nerves, including the sympathetic system. The growths were not classified as true neuromas, which must consist of both nerve tissue and nerve cells, but were termed "neurofibromatosis" by von Recklinghausen who believed that the tumors were chiefly fibrous and arose from the connective tissue sheath of the nerves. Tumors of this type involving the cranial nerves were found chiefly on the auditory nerves but were also found on the optic and trigeminal nerves.

Verhoeff,[1] in 1932, cited in a series of four cases a glioma of the optic nerve associated with von Recklinghausen's disease. He stated that "it does not follow that the tumor of the optic nerve is related to fibroma of the peripheral nerves, except to the extent that both may be dependent upon some congenital development anomaly."

In a case reported by Van der Hoeve[2] were found swelling at the optic disc and a detached retina in one eye; in the other eye, a choked disc and two small retinal tumors. Several years later, on autopsy, microscopic examination showed these retinal tumors to be composed of the same type of fibrous cells as are found in the closely allied diseases tuberous sclerosis and von Hippel-Lindau's disease.

Davis,[3] in 1940, reviewed a collection of cases in regard to clinical features and pathology. He maintained that the eye condition is due to a primary tumor of the optic chiasma or one of both nerves and that in those cases subjected to histologic examination the tumor was always a glioma.

The association of primary optic atrophy with von Recklinghausen's disease cannot be disregarded as a sufficient number of cases presenting the two conditions in each case have been reported to show this close association. Rea[4] states, "When in von Recklinghausen's disease optic atrophy is found, it may be the direct result of pressure on the optic nerve by a tumor, or may be consecutive to a

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papilledema resulting from raised intracranial pressure produced by an intracranial growth." Jefferson[5] presented a case of von Recklinghausen's disease in which the growth of a fibroma enlarged the right optic canal. This tumor was removed by opening the roof of the orbit and canal.

## Report of a case

*History.* A white seaman, aged 42 years, was admitted to the U. S. Public Health Service Hospital, Seattle, Washington, because of a nonhealing ulcer on the left forearm. At the age of 15 years, he received burns of both forearms and the right shoulder region. These areas healed without difficulty and he experienced no symptoms until one month prior to hospital admission. At this time a pea-size nodule was noted within the burned area of the left forearm which subsequently broke down and ulcerated.

At the age of 20 years following an appendectomy, he noted for the first time nodules appearing over his back and abdomen. However, since birth there had been present spongy growths over the right occipital scalp region, remaining the same size. He had one brother and sister alive. There was no history of hereditary familial disease. He had completed only the fourth grade in grammar school, expressing difficulty in his ability to learn.

Visual disturbance began at the age of 27 years, at which time he noted blurring of print. About eight years later the right eye became much worse than the left eye. This had progressed so that at present examination vision in the right eye was reduced to gross movements only. There was no history of headaches or ocular pain. History of auditory disturbances or vertigo was negative.

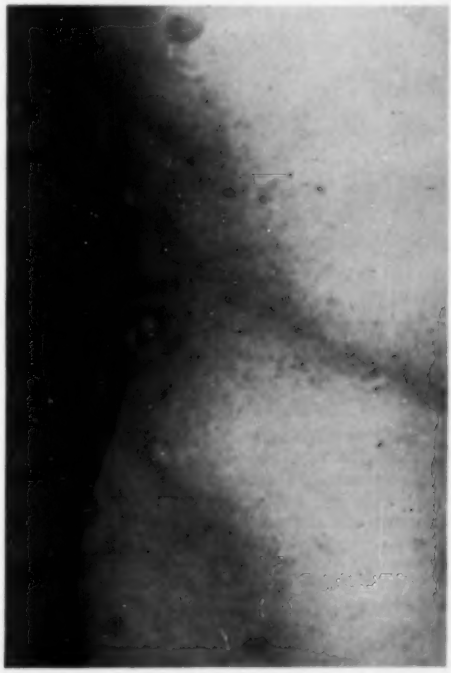

Fig. 2 (Miller and van Herick). Nodules and café-au-lait spots on body.

Fig. 1 (Miller and van Herick). Fibromatous lesions on the scalp.

Fig. 3 (Miller and van Herick). Nodules and café-au-lait spots on back.

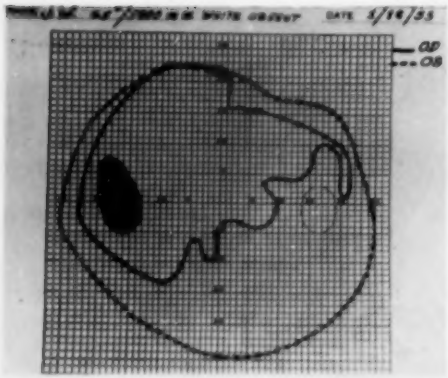

Fig. 4 (Miller and van Herick). Visual field study.

*Physical examination.* Weight 132 lb. Blood pressure 180/120 mm. Hg. The patient was very cooperative and alert. Scattered over the scalp, chest, back, abdomen, and upper and lower extremities were the typical fibromatous nodules and the well-known café-au-lait pigmented patches of von Recklinghausen's disease. In addition, there were the burn scarred areas mentioned above and the purulent ulcer with its raised edges over the left forearm scarred area (figs. 1, 2, and 3).

*Ophthalmologic examination.* Vision, uncorrected: Distance, R.E., 20/400; L.E., 20/40—1. Near, R.E., less than J11; L.E., J8. Vision, corrected: Distance, R.E., +1.25D. sph. = 20/400. L.E., +1.25D. sph. ⊃ —0.75D. cyl. ax. 90° = 20/30—1; Near, Add +1.5D., O.U.: R.E. less than J11; L.E., J3.

The adnexa showed nothing of note. The bulbar and palpebral conjunctiva showed no nodules. Bilaterally the cornea, anterior chamber, and iris were normal. The pupils reacted to light and accommodation, were round and equal. Lenticular changes were consistent with his age.

Funduscopic examination revealed bilateral primary optic atrophy, being of advanced degree in the right eye. Bilaterally temporal pallor was more marked than nasal pallor. There was a hypertensive retinopathy of mild degree present. Exudates and hemorrhages were absent, and there was no evidence of papilledema.

Extraocular muscle movements were normal in the cardinal directions of gaze, and there was no ptosis or proptosis present. Ocular tension in each eye was 26 mm. Hg (Schiøtz). Transillumination studies were also negative.

Peripheral fields bilaterally showed concentric contraction with no significant change for white, red, or blue target objects. The peripheral field of the right eye showed more marked contraction and a scotoma present in the area of the blindspot. This was mapped out more accurately on the tangent screen and was shown to extend to and also involve the perimacular area. The tangent screen field of the left eye showed enlargement of the blindspot only (figs. 4 and 5).

Audiograms were normal. X rays of the sella turcica, optic foramen, and auditory meatus were normal. Wassermann test was negative. White blood count, 10,800; neutrophils, 77 percent; lymphocytes,

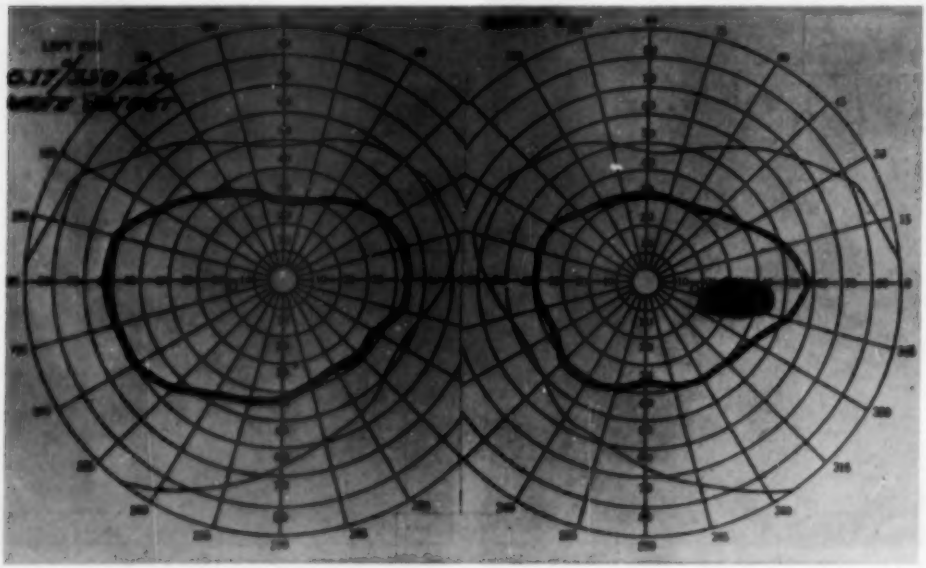

Fig. 5 (Miller and van Herick). Visual field study.

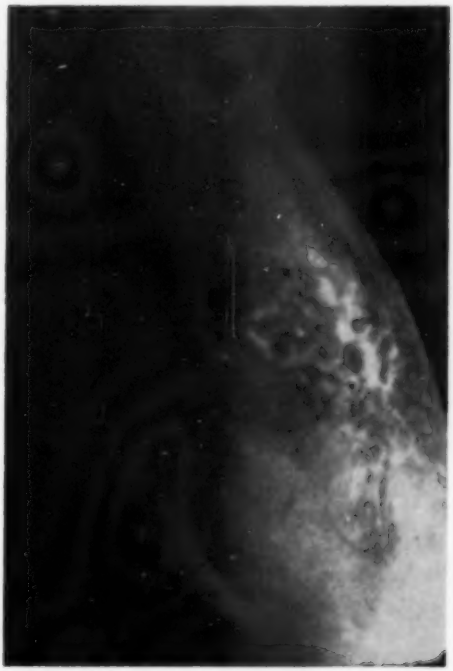

Fig. 6 (Miller and van Herick). Squamous-cell carcinoma grade II of the left forearm.

20 percent; eosinophils, three percent. Hemoglobin 15.8 gm. percent. Sedimentation rate 19 mm. per hour. Electrocardiogram was normal.

A biopsy taken from a typical nodule on the back confirmed the diagnosis of von Recklinghausen's disease, and a biopsy taken from the ulcerated area of the left forearm proved to be a squamous-cell carcinoma, grade II. The lesion was excised and the defect repaired with a split-thickness skin graft. Ocular treatment at this time was not instituted (fig. 6).

## Pathology

Hudson[6] (1940) stated that the majority of optic-nerve tumors could be classified histologically according to their origin in the glial tissue of the nerve or the tissue of the sheath, meningo-endotheliomas comprising most of the latter type.

Davis (1940) found most optic-nerve lesions to be gliomas and occasionally an endothelioma. The vast majority of gliomas arise from the intraorbital portion of the optic nerve, being rare from the chiasma or intracranial portion (Duke-Elder,[7] 1940).

Goldsmith[8] states, "When the ocular structures and their adnexa are involved in neurofibromatosis, the parts attacked, in the order of frequency, are the eyelids and the optic nerve; the orbit; the retina; the uvea (iris, choriod, and, rarely, the ciliary body); the cornea; the tarsal conjunctiva; and, lastly, the bulbar conjunctiva."

The gross appearence of the tumor is a smooth elastic nodule covered by dura, and cut section of the optic nerve reveals a diffusely thickened nerve. Histologically, cysts filled with a mucinous substance are a common occurrence. The neoplastic tissue permeates the interseptal spaces and the septa usually become thickened.

The tumor itself is made up of collagenous fibers arranged in irregular masses and into which glial tissue infiltrates and proliferates. Duke-Elder[7] (1940) states that most authorities now agree the neoplastic tissue is glial in nature and is a uni- or bipolar spongioblast type. Occasionally mitotic figures may be seen. The cells are long, spindle-shaped, and have oval nuclei.

## Review of Clinical Features

*Incidence and heredity.* Davis (1940) states that the incidence of optic nerve and chiasmal tumors in association with peripheral neurofibromatosis is 10 percent. Out of a total of 380 cases of optic nerve tumors, 38 had cutaneous manifestations consistent with a diagnosis of von Recklinghausen's disease.

Numerous cases of hereditary central neurofibromatosis have been recorded. Thomson[9] (1900) showed that the hereditary nature of this disease is fairly well established. Most authors feel that it is transmitted as a Mendelian dominant factor.

*Sex incidence.* A review of 49 recorded cases showed a preponderance in the female sex (Dresner and Montgomery[10]).

*Age.* This is a disease of children and of young people. Willis[11] gives the peak incidence of gliomas in general as occurring in the second half decade.

*Fundus appearances.* Optic atrophy may be unilateral or bilateral, depending on whether the prechiasmal portion of one nerve only or the chiasma or both nerves are involved. Papilledema may be superimposed on atrophy through involvement of the third ventricle by a chiasmal neoplasm with the production of internal hydrocephalus. Papilledema is a frequent occurrence when the tumor lies within the orbit. In these cases there is often a progressive exophthalmos, which is followed by deterioration of vision.

*Exophthalmos.* This feature is common in intraorbital tumors and when the growth extends through the optic foramina to a sufficient degree to displace the orbital contents. The occurrence of exophthalmos in a case of chiasmal tumor is pathognomonic of a glioma (Brown,[12] 1938).

*Visual fields.* Visual field defects and chiasmal lesions are variable. Atypical hemianoptic defects may occur and blind areas may be ill-defined. Frequently the fields are generally constricted as was demonstrated by Dandy.[13]

*Cutaneous lesions.* This clinical feature may be easily overlooked. Some authors have classified the skin lesions of von Recklinghausen's disease, together with the skin pigmentation, as being the commonest feature.

Thannhauser[14] states that the pigmented spots of the café-au-lait variety are as much an indication of this disease as is the neurofibromatous nodule itself. The importance of associated cutaneous signs of neurofibromatosis in making the diagnosis of optic nerve glioma more certain has been stressed by Jefferson.[15]

*Radiography of the skull.* In advanced cases of chiasmal glioma the apparent extension of the sella under the anterior clinoids from distention of the optic foramen is in evidence.

Direct views of the foramina may show enlargement if the tumor extends forward to involve them. An enlarged optic foramen associated with a glioma of the intraorbital nerve type indicates backward extension of the growth into the cranial cavity. However, an intact foramen in these cases does not preclude such backward extension since cases of this nature have been described by Rand and Reeves[16] (1939).

Occasionally, as stated by Dresner and Montgomery,[10] optic atrophy is due to a diffuse gliosis or early tumor formation, and in these cases associated radiologic signs are absent.

A summary of Farberow's[17] article on "Neurofibromatosis von Recklinghausen" includes the following:

1. X-ray examination of the skull is indicated in cases where there are swellings on the head.

2. The most common deformations of the skull are in the region of sight.

3. An enlargement of the sella turcica is most commonly met in cases of neurofibromatosis von Recklinghausen when tumors are present in the orbit.

4. The enlargement of the optic canals and formation of defects in the orbital walls are uncommon in cases of tumors in the neighborhood of the orbit.

5. The roentgenologic findings offer no grounds for the assumption that the hypophysis plays a part in the development of neurofibromatosis von Recklinghausen.

*Prognosis.* The treatment depends upon several factors. The lack of evidence suggesting a space-occupying lesion and negative findings for intraorbital involvement contraindicate surgical intervention. Generally speaking, neurofibromas are slow growing and do not metastasize readily (Jefferson,[15] 1940; Duke-Elder,[7] 1940).

The treatment for intraorbital tumors is surgical removal, but surgical intervention for chiasmal or intracranial lesions has proven to be unsatisfactory. X-ray irradiation also has not met with much success. Prognostically, these tumors eventually prove fatal by cerebral extension if left alone. However, if the tumor can be completely removed, the prognosis is good. Partial removal has value in prolonging life because of

the very nature of the slow growth of the tumor.


## Summary

A case of primary optic atrophy associated with the clinical and pathologic features of von Recklinghausen's disease has been reported.

A brief summary of the pathology, incidence, heredity, and clinical features has been presented.


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## References


1. Verhoeff, F. H.: Tumors of the Optic Nerve: Cytology and Cellular Pathology. Philadelphia, Saunders, 1932, p. 725.
2. Van der Hoeve, J.: Am. J. Ophth., 8:101, 1925.
3. Davis, F. A.: Arch. Ophth., **23**:735 and 937, 1940.
4. Rea, R. L.: Neuro-ophth., **13**:367, 1941.
5. Jefferson, G.: Brain, 1937, Pt. 4, p. 444. (Neurol. Congr., London, 1935.)
6. Hudson, A. C.: Proc. Roy. Soc. Med., **33**:685, 1940.
7. Duke-Elder, W. S.: Textbook of Ophthalmology, St. Louis, Mosby, 1940, v. 3, pp. 3080, 3088.
8. Goldsmith, J.: Arch. Ophth., **41**:718 (June) 1949.
9. Thomson, A.: Neuroma and Neuro-Fibromatosis. Edinburgh, Turnbull and Spears, 1900.
10. Dresner, E., and Montgomery, D.: Primary optic atrophy in von Recklinghausen's disease. Quart. J. Med., **18**:93, 96, 1949.
11. Willis, R.: Pathology of Tumors. St. Louis, Mosby Co., 1948, p. 802.
12. Brown, T. H.: Tr. Ophth. Soc. U. Kingdom, **59**(II):961 or 103, 1938.
13. Dandy, W. E.: Am. J. Ophth., **5**:169, 1922.
14. Thannhauser, S. J.: Medicine, **23**:105, 1944.
15. Jefferson, G.: Proc. Roy. Soc. Med., **33**:685, 1940.
16. Rand, C., and Reeves, D.: Arch. Ophth., **21**:799, 1939.
17. Farberow, B. J.: Roentgenologisches Schaedelbild bei Neurofibromatosis. **69**:81 (Zeit 8 Augen) 1936.


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# THE ACTION OF CURARE ALKALOIDS ON THE PUPIL*


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The application of curare to ocular surgery[1] has increased the interest in the actions of this drug on the different structures of the eye. There have been many reports of experiments concerning its pupillary effect and some appear to contradict each other.

In birds and reptiles, where the iris is formed by striped muscle, Meyer and others[2] found that the pupil is dilated by local curare. Other animals have been described as having a variable response to the action of the drug, and this has received different interpretations.

Drucker and co-workers[3] disclosed that, in humans, tubocurarine and dimethyl tubocurarine do not affect the size of the pupil unless doses are given which interfere with respiration. To increase our knowledge on this subject and to study the effects of miotics after the use of curare, the present experiment was performed.

## Method

Groups of five albino rabbits with a weight varying between 2.5 and 5.0 lb. were used. Two curare alkaloids, tubocurarine chloride† and dimethyl tubocurarine chloride‡ were given and their action on the iris studied after systemic and local administration by measuring the pupil every five minutes with a ruler.

Dosage varied between 0.016 and 0.10 ml. intravenously and locally; dimethyl tubocurarine in general was used in smaller

* From the Wills Hospital Research Department.

† Tubocurarine chloride supplied as an isotonic solution with a pH of 3.45 containing 20 units per ml. equivalent to 3.0 mg.

‡ Dimethyl tubocurarine chloride with a pH of 6.5 contains 20 units per ml. equivalent to 1.0 mg.

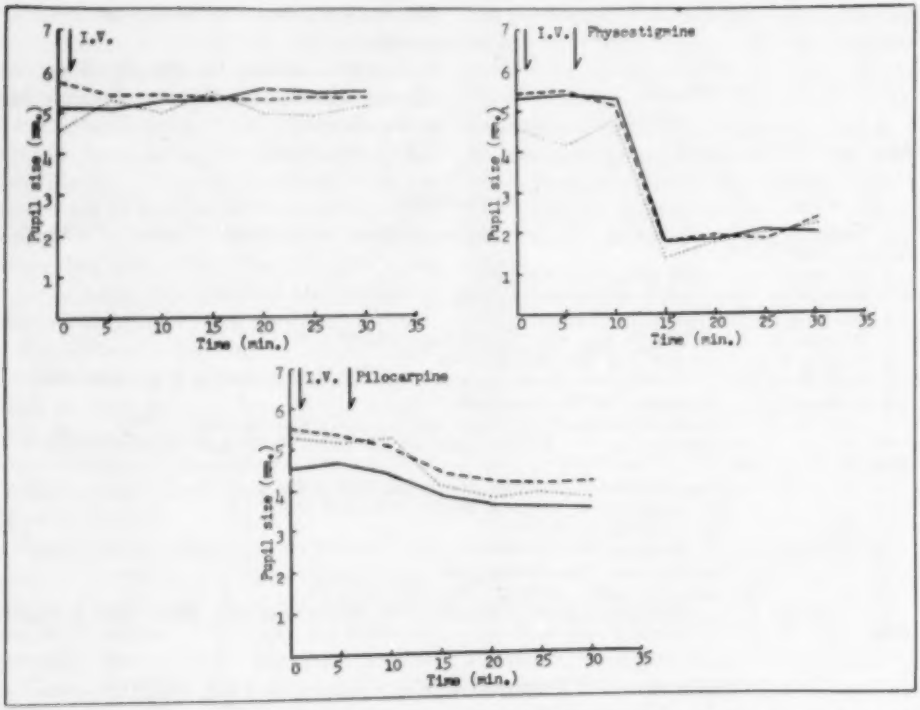


Fig. 1 (Wudka and Leopold). Pupillary diameter after intravenous administration of curare alkaloids and topical instillation of miotics. ——— Normal saline. – – – – Tubocurarine chloride. . . . . Dimethyl tubocurarine chloride.

quantities because of the greater sensitivity of the animals' vital centers to this drug. Controls were carried using normal saline.

The drugs were administered systemically by rapid intravenous injection and the dosage regulated so that interference with respiration would be negligible. This was followed in five minutes by instillation in the conjunctiva of two drops of physostigmine salicylate (two percent) or pilocarpine nitrate (two percent).

Observations were made in two groups of animals following toxic doses which produced embarrassment of respiration and cyanosis. Local effects of the drugs were studied by topical application, subconjunctival and retrobulbar injections, and introduction into the anterior chamber of the eye; in all these instances systemic manifestations were avoided.

## Results

Intravenous administration of both curare alkaloids did not have any significant effect on the pupils. After administration of physostigmine and pilocarpine, the pupils of the curare-treated animals reacted the same way as those of the saline controls (fig. 1).

With higher doses of the curare alkaloids when toxic manifestations appeared, changes occurred in the pupil consisting of rapid oscillations in size accompanied by respiratory hippus. There was first a general tendency toward myosis, that was followed by a wide mydriasis shortly before death.

Topical instillation, subconjunctival and retrobulbar injections did not alter the pupillary size significantly. The same results were obtained after introduction of tubo-

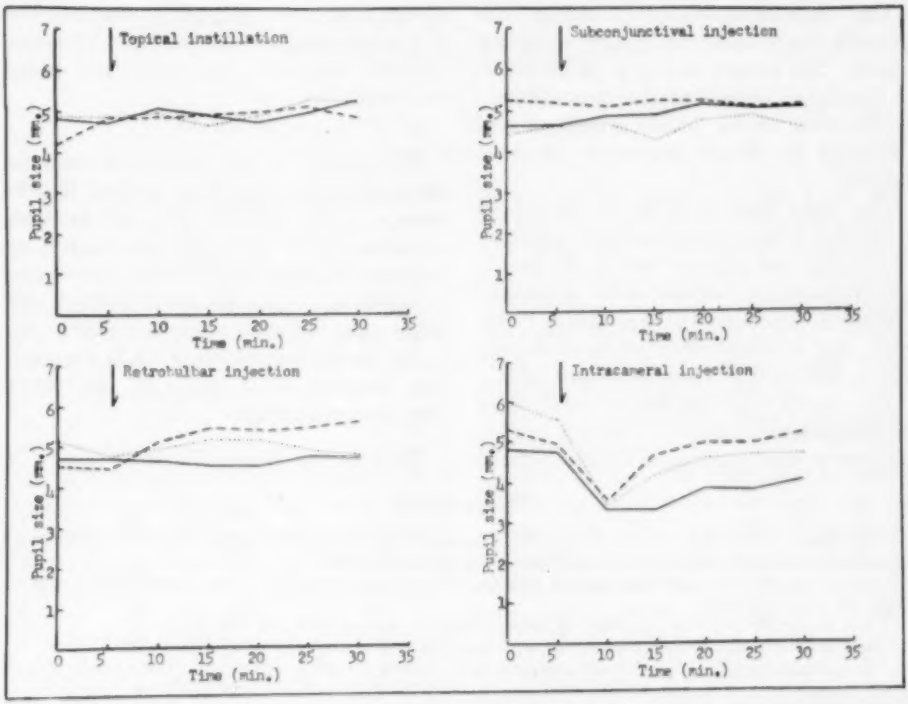


Fig. 2 (Wudka and Leopold). Pupillary diameter after local administration of curare alkaloids. —— Normal saline. - - - - - Tubocurarine chloride. . . . . Dimethyl tubocurarine chloride.

curarine and dimethyl tubocurarine in the anterior chamber (fig. 2).

## Discussion

To understand the pupillary phenomena produced by curare, we have to consider the histologic structure of the iris. As has been mentioned, in birds and reptiles the intraocular musculature is of striped nature and unlike that of other animals has its myoneural transmission blocked by local application of curare which results in the development of mydriasis.

In humans and other mammals where the iris is composed of smooth fibers, the following descriptive stages can be distinguished after systemic administration:

*The first stage* consists of relaxation of voluntary muscles of the head, neck, and extremities with only slight reduction in the pulmonary vital capacity.[4] At this point in our study no significant modifications were observed in the neurohumoral mechanisms that control the pupillary size and the iris responded normally to physostigmine and pilocarpine.

In ophthalmic practice, the use of curare alkaloids is usually confined within the limits of this stage and no interference with the action of miotics should be observed when they are used after surgery.

*The second stage* is represented by severe interference with respiration due to weakness of the intercostal muscles and the diaphragm resulting in unbalanced gaseous exchange and development of cyanosis. Wide variations in the pupillary size are caused primarily by central actions with paralysis of the ciliary ganglion as a contributory factor.[5]

The central-nervous-system effects are probably due to anoxia and excess of carbon dioxide. The former acts first by inhibition of the higher cortical mechanisms followed by liberation of the midbrain centers,[6] and afterward by direct depression of these nuclei.

*The third stage* may be recognized by paralysis of the parasympathetic pupillary innervation that appears first in the ganglionic transmission and later at the myoneural junction.[5] This explains the dilatation of the pupil that develops when artificial respiration is instituted to keep the animal alive.[7]

*The fourth stage* consists of paralysis of the sympathetic pathways to the iris that are apparently very resistant to curare. Actually dosage four times as great as that required to produce complete muscular paralysis does not interfere with the sympathetic transmission.[5]


## Summary

The actions of two curare alkaloids on the pupil of the rabbit were studied. Results were recorded after systemic and local administration and also after conjunctival instillation of physostigmine and pilocarpine.

Significant variations were obtained only when toxic doses were given intravenously.

An attempt was made to classify the pupillary behavior under curare by considering four successive stages.


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## References


1. (a) Baird, J. W., Johnson, W. R., and Van Bergen, F. H.: Pentothal-curare solution: A preliminary report and analysis of its use in 160 cases. Anesthesiology, **9**:141, 1948.
   (b) Boles, W. M.: Combined sodium pentothal and local anesthesia for selected cases of eye surgery. South. M. J., **42**:13, 1949.
   (c) Kirby, D. B.: Use of curare in cataract surgery. Arch Ophth., **43**:678, 1950.
   (d) Roche, J. R.: Research in the use of curare for ocular surgery. Am. J. Ophth., **34**:91, 1950.
   (e) Abramovitz, L. J.: Combined anesthesia with sodium pentothal, curare, and nitrous oxide: Report of 625 cases. Anesth. & Analg., **29**:223, 1950.
   (f) Farquharson, H.: Curare with local anesthesia in cataract surgery. Am. J. Ophth., **34**:554, 1951.
   (g) Cordes, F. C., and Mullen, R. S.: The use of curare in cataract surgery. Am. J. Ophth., **34**: 557, 1951.
   (h) Barraquer Moner, J. L.: El curare en cirugia ocular. Sem. Med., **58**: 342, 1951.
2. (a) Meyer, H. H.: Ueber einige pharmakologishe Reactionen der Vogel und Reptilieniris, Arch. f. exper. Path. u. Pharmakol., **32**:101, 1893.
   (b) ———: Ueber Curarin. J. Pharmacol. & Exper. Therap., **29**:1, 1926.
   (c) Zelenski, von aus Petersburg: Zur Frage von der Muskelirritabilitat, Arch. f. path. Anat., **24**: 362, 1862.
3. Drucker, A. P., Sadove, M. S., and Unna, K. R.: Ophthalmic studies of curare and curarelike drugs in man. Am. J. Ophth., **34**:543, 1951.
4. Unna, K. R., Pelikan, E. W., Macfarlane, D. W., Cazort, R. J., Sadove, M. S., Nelson, J. T., and Drucker, A. P.: Evaluation of curarizing drugs in man, J. Pharmacol. & Exper. Therap., **98**:318, 1950.
5. Guyton, A. C., and Reeder, R. C.: Quantitative studies on the autonomic actions of curare. J. Pharmacol. & Exper. Therap., **98**:188, 1950.
6. Adler, F. H.: Physiology of the Eye, St. Louis, Mosby, 1950, p. 388.
7. McIntyre, A. R.: Curare: Its History, Nature and Clinical Use, Chicago, Univ. Chicago Press, 1947, pp. 177-178.

# THE UPTAKE OF RADIOACTIVE PHOSPHORUS BY INTRAOCULAR NEOPLASMS*

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It frequently happens that ophthalmologists will disagree as to the proper course of action when confronted with a fundus lesion in which malignancy is suspected. Some will vote for immediate enucleation; others will advocate a policy of watchful waiting, being uncertain as to the diagnosis.

In patients in whom the vision of the fellow eye is defective, the decision assumes paramount importance. Hence, it was hoped that with the advent of radioactive isotopes these substances might be used as a reliable diagnostic aid in suspected tumor cases. There has been ample evidence in other fields of medicine to believe this might be the case.

## BACKGROUND

In 1945, Forssberg and Jacobsson[1] showed that when radioactive phosphorus was injected into rabbits previously grafted with carcinoma, it concentrated more in the tumor tissue than in normal tissues. Other investigators[2] have noted the increased uptake of certain radioactive materials in tumors of the human body.

In 1949, Selverstone, Soloman and Sweet,[3] using radioactive phosphorus ($P^{32}$), reported accurate localization of deep brain tumors by means of a specially designed Geiger-Mueller counter probe. This work led one of us (E. B. D.) to study the relative uptake of $P^{32}$ in various ocular tissues and in malignant tumors of the eye.

Preliminary studies were undertaken in 1949 and 1950 by Dunphy and Selverstone.[4] Weighed aliquots of various ocular tissues dissected from eight enucleated eyes were subjected to radioactive assay following the intravenous use of $P^{32}$.

Two of these eyes were later proven to contain malignant melanomas and three retinoblastomas. Two were old blind glaucomatous eyes, and one was a normal eye obtained at autopsy from a patient who died from an inoperable brain tumor.

The results of this study showed that $P^{32}$ concentrated in the vascular tissues of the eye more than in the nonvascular tissues and intraocular fluids. They also showed that in four of the five neoplastic eyes studied, the activity of the tumor was somewhat higher than that of choroid or retina.

In 1952, Thomas[5] and his co-workers reported their results in the detection of intraocular tumors using $P^{32}$ intravenously in eight patients. An attempt was made to diagnose the tumor in vivo as well as in vitro by means of an end-window type of Geiger counter applied to the eyeball.

Of the six eyes in which the counts were significantly higher over the area of the suspected tumor, five were enucleated and were proven to contain malignant melanomas. The remaining lesion was diagnosed as a metastasis from a known breast carcinoma and no operation was done.

Two other patients gave no increased counts and were not operated upon. One of these had a cyst of the anterior chamber and the other a serous detachment of the retina.

In all eight eyes the lesions were either in

* From the Ophthalmic Service of the Massachusetts Eye and Ear Infirmary, the Neurosurgical Service of the Massachusetts General Hospital, and the Department of Ophthalmology and Surgery, Harvard Medical School. Aided by a grant from the Barker Foundation and by grants from the Atomic Energy Commission under Contract No. AT (30-1)—1242. Presented at the 89th annual meeting of the American Ophthalmological Society, Hot Springs, Virginia, May, 1953. This article will appear in the *Transactions of the American Ophthalmological Society*, 1953. It is printed here with the permission of the American Ophthalmological Society and the Columbia University Press.

the anterior part of the globe or in the equatorial region and hence accessible to the application of the Geiger counter.

Thomas and his collaborators also showed by pathologic examinations and radioautographs that $P^{32}$ concentrated in the tumor tissue to a higher degree than it did in certain non-neoplastic tissues.

In order to overcome the inaccessibility of posterior lesions, Trevor-Roper[6] and coworkers in England proposed the use of another isotope, $I^{131}$, which had been used by Moore[7] and others in the diagnosis of tumors of the central nervous system. This is a gamma emitter, whose penetrating rays have an absorption half-thickness in tissue of 50 to 60 mm., in contrast to $P^{32}$, the similar figure for which is about 1.0 mm. with a maximum range of only 7.0 mm.

$I^{131}$, as di-iodofluorescein, was given to eight patients with intraocular tumors, later proven to be malignant melanomas. Counting was begun two to four hours after injection at various positions on the eyeball and corresponding positions on the fellow eye. In all cases the counts were quite low and were not significantly different from the fellow eye. The authors concluded that this technique could not be recommended as a routine diagnostic procedure.

It should be borne in mind, however, that in using $I^{131}$ one encounters the disturbing effect of a high background gamma radiation from adjacent tissues, which obscures that arising from the tumor. A small probe counter placed lateral to or behind the eyeball can be shielded to prevent entrance of Beta particles from $P^{32}$ but not of gamma rays from $I^{131}$. Hence, it would seem that $P^{32}$ is a much better isotope to employ in the study of ocular tumors. It has a half-life of 14.3 days and consequently adequate supplies can be kept on hand to allow the test to be made conveniently. It is perfectly safe to administer in proper dosage.

Fig. 1 (Dunphy, et al.). Geiger counter.

## Present Study

Our present report concerns our results in using $P^{32}$ intravenously in 12 cases. Five of the eyes were subsequently proven to contain malignant melanomas of the choroid, two were retinoblastomas, and one a tumor of the iris and ciliary body. One was a benign cyst of the iris, one an absolute glaucoma, one a Sturge-Weber syndrome with glaucoma and one an old retinal detachment. Hence there were eight eyes containing malignant tumors and four with benign pathologic lesions.*

## Method

At periods varying from 15 to 90 minutes before operation 0.076 to 1.72 millicuries of $P^{32}$ as buffered phosphate solution was given intravenously, according to the patient's weight and age.† The probe counter of Robinson and Peterson[8] was used in 10 of the 12 cases (fig. 1). In the other two a conventional end-window type was utilized.

In the two cases with iris lesions, the counter was applied over the lesions preoperatively and in vivo counts were obtained. In the remaining cases, in which the lesions were all posterior, no attempt was made to

* All pathologic examinations were made by Dr. Parker Heath, with aid from the Kresge Fund for Eye Pathology, at the Massachusetts Eye and Ear Infirmary.

† Dosage: 20 mc. per kg. of body weight for adults. 8.0 mc. per kg. of body weight for children.

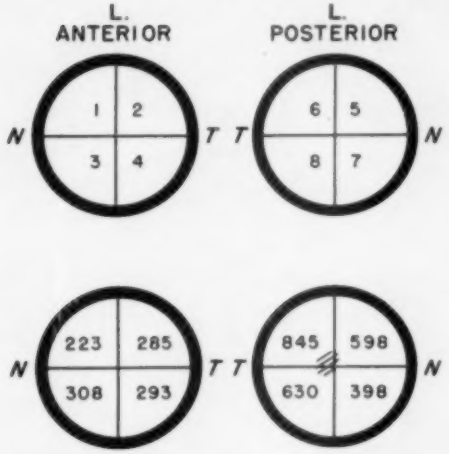


Fig. 2 (Dunphy, et al.). Upper diagram shows division of left eyeball into the eight surface areas. Lower diagram shows sample counting over each area of Case 1. The cross-hatched zone overlapping areas 6 and 8 represents location of tumor.

get in vivo counts, except in one instance where there was a large retinoblastoma.

Following enucleation, the eyeball was placed in a glass jar without fixative and taken directly to the laboratory. The surface of the globe was then demarcated into octants, four anterior to the equator and four posterior (fig. 2). The Geiger counter was placed over the midpoint of each area and readings taken for one minute.

Readings were also taken over that area of the sclera exactly overlying the tumor, as far as it could be determined by ophthalmoscopy and transillumination. The values were corrected for background and for decay of $P^{32}$. The figures shown represent the average of two readings in each case.

## Case reports

### Case 1

A 22-month-old male infant was admitted August 18, 1952, because the parents, two months previously, had observed a gray reflex in the left pupil.

*Ophthalmoscopic examination* of the left eye revealed a large white tumor mass in the posterior half of the globe reaching far into the vitreous.

The right eye was normal.

*Diagnosis.* Retinoblastoma, left eye.

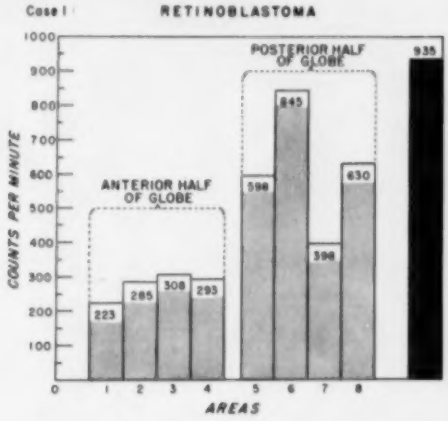


Fig. 3 (Dunphy, et al.). Postenucleation counts in Case 1. In this chart and subsequent charts, the black column represents counts directly over suspected tumor.)

Enucleation was performed 19 minutes after intravenous injection of 0.076 millicuries $P^{32}$ (8.0 mc. per kg. body weight).

Transillumination of the enucleated globe showed that the tumor was located in the posterior four areas of the eyeball, predominantly in the areas 6 and 8 but also to a lesser degree in the areas 5 and 7.

*Pathologic report.* Typical retinoblastoma with considerable necrosis. No extension noted in cross sections of the optic nerve.

### Case 2

A man, aged 47 years, was admitted August 22,

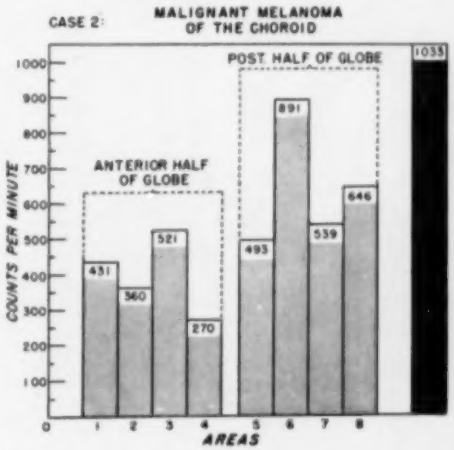


Fig. 4 (Dunphy, et al.). Postenucleation counts in Case 2.

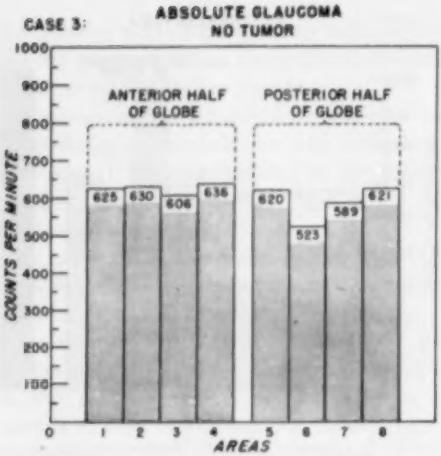


Fig. 5 (Dunphy, et al.). Postenucleation counts in Case 3.

1952, because of flashes of light and failing vision in the right eye for some months.

*External examination and biomicroscopy* showed a normal anterior segment. By ophthalmoscopy was seen a large, solid-looking separation of the retina in the upper posterior temporal quadrant extending down into the lower posterior temporal quadrant in the equatorial zone.

Transillumination was positive. The left eye was normal.

*Diagnosis.* Malignant melanoma of the choroid, right eye.

Enucleation was performed 43 minutes after an intravenous injection of 1.69 millicuries $P^{32}$ (20 mc. per kg. of body weight).

Transillumination of the enucleated globe confirmed the clinical observation that the tumor tissue was mostly located in the area 6 extending down into area 8.

*Pathologic report.* Malignant melanoma arising from the choroid. It has not invaded the retina or the sclera significantly. The cell type is small epithelioid with a few spindle-B cells.

CASE 3

A woman, aged 76 years, was admitted September 30, 1952, for enucleation of a painful blind right eye.

*Diagnosis.* Absolute glaucoma.

At no time was tumor suspected, and the case is included in the material as a control nontumor eye.

Enucleation was made 37 minutes after an intravenous injection of 1.14 millicuries of $P^{32}$.

Transillumination was negative.

*Pathologic report.* Senile changes in the uvea and retina. Incomplete peripheral anterior synechias and moderate cataractous changes in the lens. No tumor. No cupping of disc.

CASE 4

A woman, aged 74 years, was admitted October 21, 1952, for absolute glaucoma of the left eye. From the patient's history it was felt that she had had an occlusion of the central retinal vein 10 years previously and that she now had an organized hemorrhage causing secondary glaucoma with a tension of 64 mm. Hg (Schiøtz).

*Preoperative transillumination* of the anterior segment was negative. No tumor was suspected in this case which was included in the material as a control eye.

Enucleation was performed 15 minutes after the

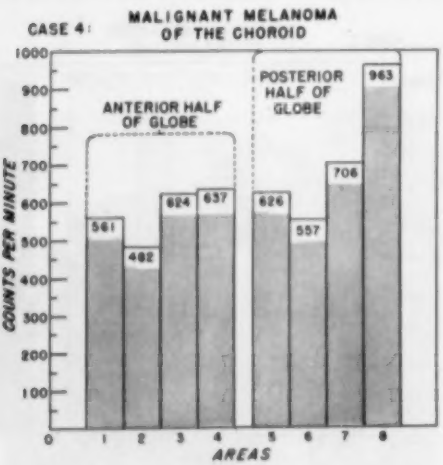


Fig. 6 (Dunphy, et al.). Postenucleation counts in Case 4.

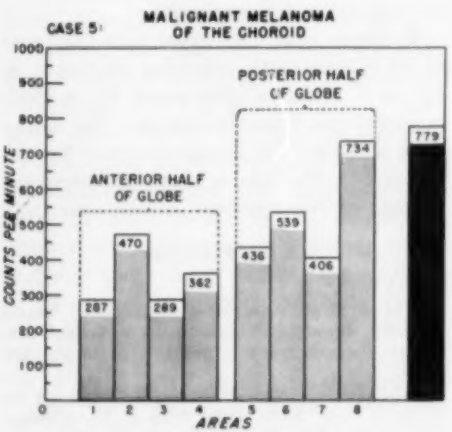


Fig. 7 (Dunphy, et al.). Postenucleation counts in Case 5.

injection of 0.794 millicuries $P^{32}$. Uniform counting over all eight areas, as in Case 3, was expected but surprisingly irregular countings were obtained.

On opening the globe a big, solid tumor was found extending forward from the posterior part of the eyeball and occupying most of the interior of the eye.

*Pathologic report.* Malignant melanoma, mixed spindle-cell B and small epithelioid cells. No extraocular extension noted.

CASE 5

A man, aged 68 years, was admitted October 9, 1952. About a year previously he had had an uneventful cataract extraction in his right eye.

After the operation a "retinal separation" was diagnosed.

*By ophthalmoscopy* was seen a large choroidal elevation, mostly located to the posterior temporal part of the fundus.

*Diagnosis.* Choroidal tumor, probably a malignant melanoma of the right eye.

Enucleation of the right eye was performed 33 minutes after injection of 1.2 millicuries of $P^{32}$. Transillumination of the enucleated globe confirmed that the tumor was located predominantly in area 8 with the greatest mass corresponding to the anterior part of the borderline between the areas 8 and 6.

*Pathologic report.* Malignant melanoma of the choroid. Moderate sized epithelioid cell type with only slight reticulum. No extraocular extension.

CASE 6

A man, aged 56 years, was admitted October 31, 1952, for an intraocular tumor of the left eye. He gave a history of blurred vision in the left upper temporal field for about two months prior to the admission.

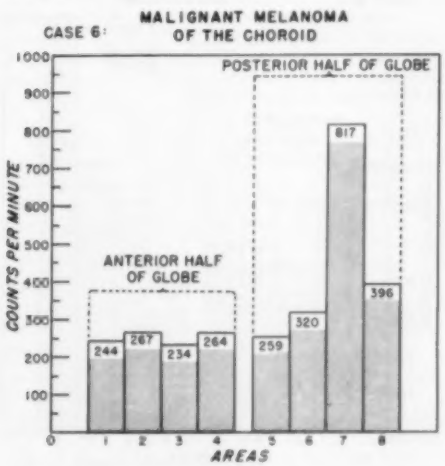


Fig. 8 (Dunphy, et al.). Postenucleation counts in Case 6.

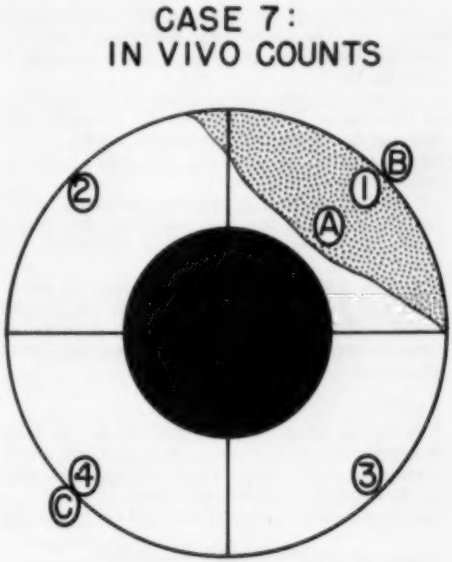


Fig. 9 (Dunphy, et al.). Diagram to show areas counted in Case 7.

A large solid separation was seen from the 6- to 9-o'clock positions, definitely confined to the nasal lower posterior quadrant.

*Diagnosis.* Malignant melanoma of the choroid, left eye.

Enucleation was performed 35 minutes after an injection of 1.47 millicuries of $P^{32}$. Transillumination of the enucleated globe confirmed that in this case the "tumor area" was identical with the midpoint of area 7.

*Pathologic report.* Malignant melanoma of the choroid. Spindle-cell A, B, and small epithelioid cells. No extraglobal extension.

CASE 7

A woman, aged 61 years, was admitted November 3, 1952, for a tumor of the iris, right eye. The tumor bulged forward into the anterior chamber and filled the angle in the region from the 12- to 4-o'clock positions. A slight flare and a few cells were seen along with many pigmented keratic precipitates on the posterior surface of the cornea. The tension measured 55 mm. Hg (Schiøtz).

*Preoperative diagnosis.* Tumor of the iris and possibly of the ciliary body.

In this patient, counting was performed on the eye in vivo, about one hour after an injection of 0.964 millicuries of $P^{32}$.

The counter was placed just inside the limbus of the four anterior areas. In addition it was also placed: (A) On the cornea with the counting area of the probe over the middle of the visible part of tumor. (B) Just outside the limbus where the tumor, which filled the angle, might be close enough

to the surface of the globe to give an increased count. (C) The counter was then placed just outside the limbus in area 4 opposite to position B (See fig. 9).

The eye was enucleated one hour 31 minutes after an injection of 0.96 millicuries $P^{32}$. Counting was made on the enucleated eye similar to the in vivo counting, and, in addition, the four posterior areas were counted as usual.

*Pathologic report.* Malignant melanoma, probably primary in the iris involving the ciliary body on the mesial side. Small epithelioid cell type.

In this case, the in vivo counts over the tumor area were no higher than those from the opposite limbal area which was free of tumor. An explanation is suggested in the legend accompanying Figure 10.

CASE 8

A female infant, aged five months, was admitted November 26, 1952, because the parents, two weeks previously, had noticed a gray reflex in the right pupil, which was dilated and fixed.

The examination showed that the vitreous cavity of the right eye was almost completely filled with a grayish mass.

*Diagnosis.* Retinoblastoma of the right eye.

The left eye was normal.

In vivo counting began about one hour after an intravenous injection of 0.06 millicuries of $P^{32}$. No

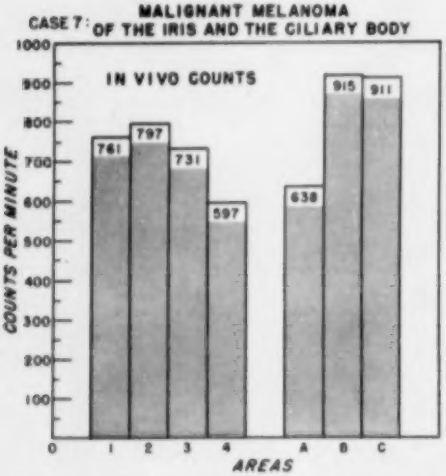


Fig. 10 (Dunphy, et al.). In vivo counts on the four anterior areas and on the three special areas in Case 7.

Note the gross discrepancy in the counting rate at the adjoining points C and 4 on the one hand and B and 1 on the other hand. The counter used was not shielded to exclude radiations from any direction, and it is apparent that a slight change in position of the counter may result in a gross change in geometric relationships and in the proportion of pickup from extraocular tissues. Thus, the counts are higher at points B and C, at which the probe is deeper within the orbit, than they are in the other positions. The unsuitability of this type of counter for in vivo work is obvious.

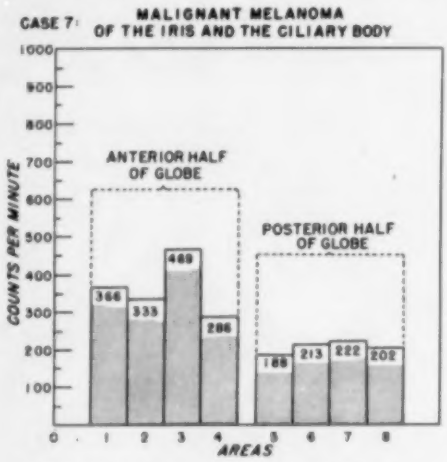


Fig. 11 (Dunphy, et al.). Postenucleation counts in Case 7.

Comparison of the counts in positions 1 to 4 here with those in the same patient in vivo 30 minutes earlier (fig. 10) shows that about half of the count rates on the living eyeball arose from extraocular tissues. The eyeball alone yields local differences in radiation adequate to permit localization of the tumor.

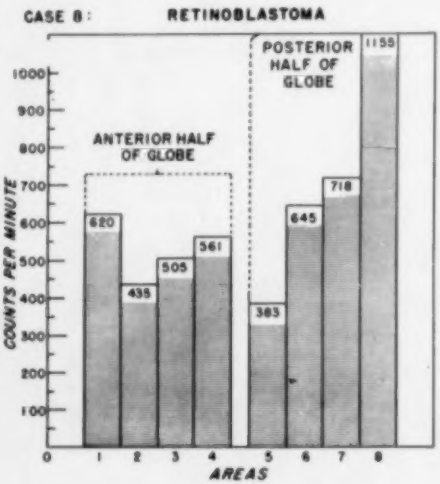


Fig. 12 (Dunphy, et al.). Postenucleation counts in Case 8.

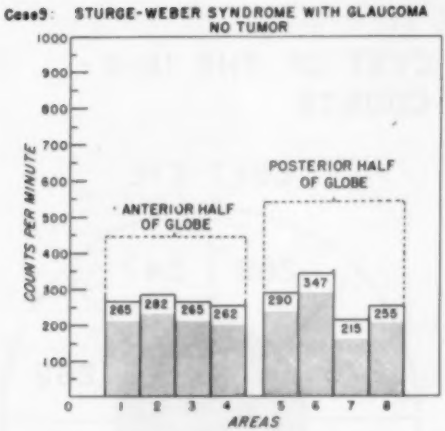


Fig. 13 (Dunphy, et al.). Postenucleation counts in Case 9.

significant difference between the four anterior areas was found; the counts per minute being as follows: area 1, 684; area 2, 746; area 3, 690; area 4, 782.

Enucleation was performed one hour and 28 minutes after the injection.

*Pathologic report.* Extensive retinoblastoma, considerable necrosis, neuro-epithelial type. No extension noted beyond the nervehead or outside the globe.

CASE 9

A boy, aged seven years, was admitted December 3, 1952, for Sturge-Weber's syndrome with glaucoma, right eye.

He had an uncontrollable glaucoma of the right eye, unsuccessfully treated with goniopuncture and cyclodiathermy. Vision was only light preception with inaccurate projection. Tension measured 87 mm. Hg (Schiøtz).

*Ophthalmoscopic examination and transillumination* showed no evidence of intraocular tumor, and the case was included as a control.

Enucleation was performed one hour and 30 minutes after an intravenous injection of 0.23 millicuries of $P^{32}$.

*Pathologic report.* Sturge-Weber syndrome, occlusive glaucoma, secluded pupil, cataractous lens changes, atrophy of the choroid, atypical choroid with small hemangioma. Early cavernous degeneration of optic nerve. Some cupping of disc.

CASE 10

A woman, aged 31 years, was admitted January 9, 1953. Six weeks previously she had noted decreased vision "like a curtain" in her left eye.

*Fundus examination* revealed a huge retinal detachment. The retina was lying like a balloon over a round mass arising just behind the equatorial region, at the junction of the upper and lower posterior nasal quadrants.

*Diagnosis.* Malignant melanoma of the left eye.

Enucleation of her left eye was performed one hour and 40 minutes after an injection of 0.96 millicuries $P^{32}$.

Transillumination of the enucleated eyeball confirmed the ophthalmoscopic localization of the tumor.

*Pathologic report.* Malignant melanoma of the choroid, mostly spindle-cell B type.

CASE 11

A man, aged 41 years, was admitted December 4, 1952, for a small cyst or tumor in the periphery of the right iris.

Preoperative counting was begun about one hour after an intravenous injection of 1.72 millicuries of $P^{32}$.

In this case a different type of Geiger counter was employed, a small, tin end-window type, which was placed both over the tumor area at the limbus and for comparison over seven other parts of the limbal region. No area showed any significant variation. As a control similar counts were made over corresponding areas of his left eye.

An iridectomy was performed, following which it became apparent that there was a dark brownish mass in the site of the iridectomy which seemed attached to the ciliary processes. This was excised.

*Pathologic report.* Benign epithelial cyst of the ciliary processes.

CASE 12

A man, aged 57 years, was admitted January 24, 1953, because of diminishing vision in his left eye for several months.

*Ophthalmoscopy* of the left eye showed a large grayish black mass with retinal separation predominantly located in the posterior nasal inferior quad-

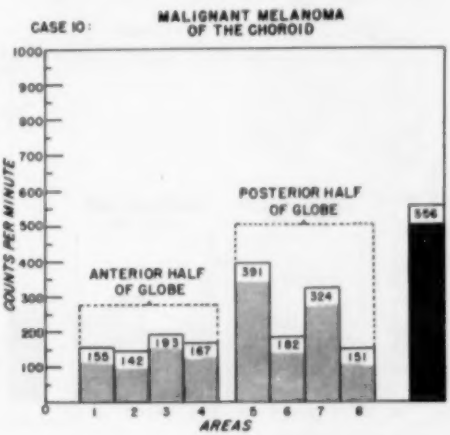


Fig. 14 (Dunphy, et al.). Postenucleation counts in Case 10.

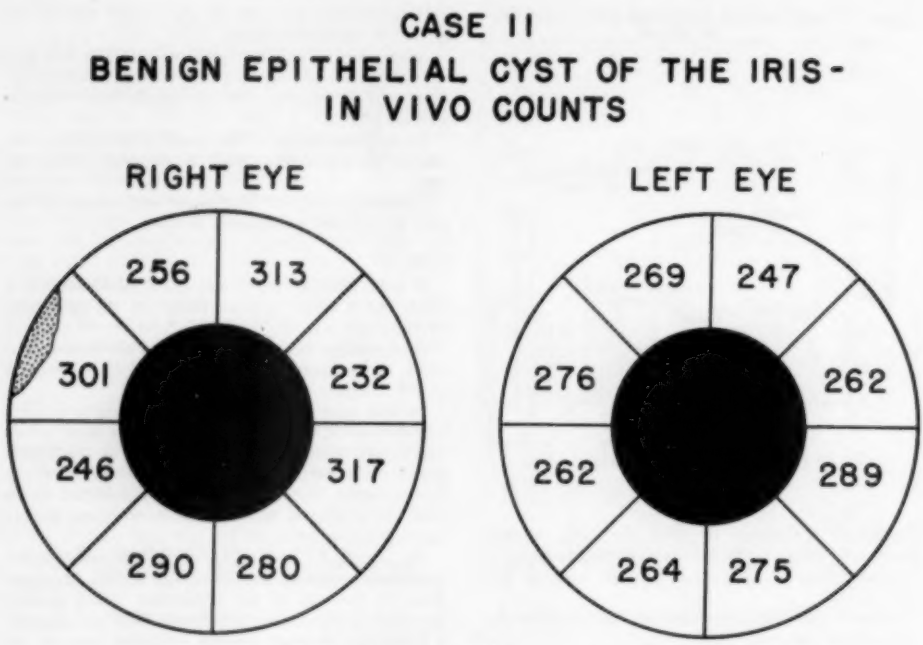


Fig. 15 (Dunphy, et al.). In vivo counts in Case 11.

rant, beginning about 1.5 disc diameter inferior to the disc, ending a little in front of the equator.

*Diagnosis.* Malignant melanoma of the left eye.

The eye was enucleated 55 minutes after an intravenous injection of 1.16 millicuries of $P^{32}$.

In this case an end-window Geiger counter was employed as in the previous case.

*Pathologic report.* Separated retina with considerable edema in the inner reticular layer and nerve-fiber layer. The retina appears considerably folded. No tumor.

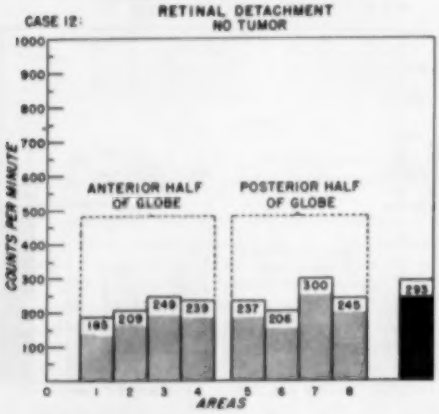


Fig. 16 (Dunphy, et al.). Postenucleation counts in Case 12.

## Discussion

The work with $P^{32}$ related to localizing cerebral neoplasms revealed that the method was effective because these tumors took up a much greater concentration of the labeled phosphate than did the normal brain, when measurements were made at appropriate time intervals after injection. This proved to be due more to the extreme sluggishness of uptake by the normal cerebrum than to very rapid uptake by the tumor.

The fact that the barrier between blood and normal brain is so high, rather than that the barrier between blood and tumor is very low, is responsible for the high differential concentrations. Indeed, such active normal tissues as liver, spleen, and bone marrow take up phosphate more rapidly than many malignant gliomas, and skeletal muscle takes

TABLE 1

ACTIVITY RATIOS OF TISSUES AT AUTOPSY

$$\frac{\text{(counts/min./mg. of tissue)}}{\text{(counts/min./mg. of white matter)}^*}$$

(From Dr. Sweet's[9] paper)

| Tissue | Activity Ratio | | |
|---|---|---|---|
| | Case 9 | Case 13 | Case 16 |
| Glioblastoma | 29.9 | 54.2 | 5.5 |
| Blood | — | — | 1.8 |
| Skeletal muscle | 26.7 | 15.5 | 2.6 |
| Cancellous bone (with marrow) | 48.6 | 56.5 | 4.4 |
| Spleen | 41.0 | 29.9 | 7.3 |
| Liver | 87.6 | 60.9 | 10.1 |

* The intervals between the time of injection and the time of death were, respectively: Case 9, 57.3 hours; Case 13, 62.2 hours; and Case 16, 364 hours.

it up at rates similar to those seen in gliomas[9] (table 1).

The method is, therefore, likely to be applicable only to tumors which grow in a bed of metabolically slow-moving normal tissue. Happily the eyeball qualifies in this respect because of the large volume of the globe taken up by the metabolically torpid sclera, aqueous and vitreous humors, cornea, and lens. (This refers to phosphate uptake, not oxygen consumption.)

The more active choroid and retina with uptake rates of the same order of magnitude as those of the ocular neoplasms are small in volume. Moreover, tumor replaces vitreous and aqueous, so that the high differential between the uptake of tumor and that of the fluids of the eyeball determines the change in counting rate caused by tumor (fig. 17).

These considerations formed the basis for our hope that $P^{32}$ as phosphate would also be useful in localizing ocular tumors.

In this particular series of cases, it is clear that the malignant lesions took up the labeled phosphate ion in sufficient amounts to permit rough localization with the Geiger counter, provided the counter was applied over the sclera close to the lesion. Since all

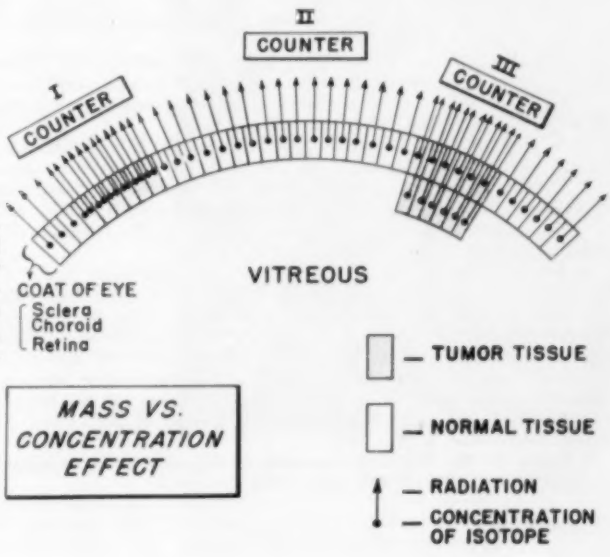


Fig. 17 (Dunphy, et al.). Increased counts may occur either because there is an actual increased uptake by the tumor, as in Counter I, or there may be no increased uptake by the tumor but, due to the increased mass of the tumor itself, increased counts may be expected.

the tumors here reported, with the exception of one iris tumor, were in the posterior half of the globe, it was not possible to obtain significantly increased readings in vivo. Therefore, only postenucleation readings are reported in these cases. In the two cases of iris lesions, in vivo readings were made.

It is obvious that, if this diagnostic method is to have any broad practical value, some type of Geiger counter must be devised which can be used behind the equator of the eyeball similar to a curved posterior transilluminator. Construction of such a counter imposes certain technical difficulties but progress is being made along these lines and it is hoped that one will be available soon.

In suspected lesions of the anterior half of the eyeball, the test may prove a valuable aid in diagnosis. However, many more cases of nonmalignant lesions will have to be studied before one can say that it can be completely relied upon. With this in view, we are now testing a series of cases of detached retina, the results of which will be reported in a subsequent paper.

## Summary

Data are reported concerning the uptake of $P^{32}$ in 12 pathologic eyes. Evidence is presented that the portion of the eye containing a malignant melanoma or retinoblastoma shows an increased uptake of this isotope. This was sufficient in comparison with the average from normal areas of the eye so that the presence and site of tumor were diagnosed by application of a counter externally to the eyeball. In lesions behind the equator of the eyeball, the types of counters now available cannot be applied closely enough in vivo to utilize this method. Hence, in such cases it would seem inadvisable for the present to rely on this test, if clinical observations indicate a different course of action.

*243 Charles Street (14).*

## References

1. Forssberg, A., and Jacobsson, F.: Studies on the Brown-Pearce rabbit carcinoma with the aid of radioactive isotopes. Acta radiol., **26**:523-534 (Nov.) 1945.

2. (a). Marinelli, L. D., and Goldschmidt, B.: The concentration of $P^{32}$ in some superficial tissues of living patients. Radiology, **39**:454-463 (Oct.) 1942.

(b). Low-Beer, B. V. A.: Surface measurements of radioactive phosphorus in breast tumors as possible diagnostic method. Science, **104**:399 (Oct.) 1946.

(c). Selverstone, B., and Solomon, A. K.: Radioactive isotopes in the study of intracranial tumors. Tr. Am. Neurol. A., 1948, p. 115-119.

(d). Selverstone, B., Sweet, W. H., and Robinson, C. V.: Clinical use of radioactive phosphorus in the surgery of brain tumors. Ann. Surg., **130**:643-651 (Oct.) 1949.

(e). Duffy, B. J., and Howland, J. W.: Radioactive phosphorus ($P^{32}$) in diagnosis and treatment. New York State J. Med., **52**:551-554 (Mar.) 1952.

3. Selverstone, B., Solomon, A. K., and Sweet, W. H.: Localization of brain tumors by means of radioactive phosphorus. J.A.M.A., **140**:277-278 (May) 1949.

4. Dunphy, E. B., and Selverstone, B.: Distribution of radioactive phosphorus in ocular tissues. Tr. New England Ophth. Soc., Am. J. Ophth., **34**:1603 (Nov.) 1951.

5. Thomas, C. I., Krohmer, J. S., and Storaasli, J. P.: Detection of intraocular tumors with radioactive phosphorus. Arch. Ophth., **47**:276-286 (Mar.) 1952.

6. Trevor-Roper, R. D., Newton, K. A., and Nicholson, J. P.: Radioactive di-iodofluorescein in the diagnosis of intraocular tumors. Brit. J. Ophth., **36**:543-546 (Oct.) 1952.

7. Moore, G. E.: (a) Fluorescein as an agent in the differentiation of normal and malignant tissue. Science, **106**:130-131 (Aug.) 1947; (b) Use of radioactive di-iodofluorescein in the diagnosis and localization of brain tumors. Ibid., **107**:569-571 (May) 1948; (c) Moore, G. E., Hunter, G. W., and Hubbard, T. B.: Clinical and experimental studies of fluorescein dyes, with special reference to their use for the diagnosis of central nervous system tumors. Ann. Surg., **130**:637-642 (Oct.) 1949.

8. Robinson, C. V., and Peterson, R. E.: A study of small Ether-Argon Geiger-Mueller counters. Rev. Scient. Instruments, **19**:911, 1948.

9. Sweet, W. H.: The uses of nuclear disintegration in the diagnosis and treatment of brain tumor. New England J. Med., **245**:875-878 (Dec.) 1951.

# THE ROLE OF CEREBRAL ANGIOGRAPHY IN OPHTHALMOLOGY*

## NORMAL ANATOMY: PRESELLAR AND SUPRASELLAR TUMORS: OCULAR COMPLICATIONS

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Cerebral angiography is the demonstration of the blood vessels of the brain on X-ray films. It is useful in the diagnosis of many organic intracranial lesions which affect the visual apparatus.

It is particularly important in cases of unexplained failing vision in which physical and neurologic examinations produce negative results and plain skull films show little or no abnormalities. In such cases, visual symptoms may be the first and for some time the only clue of an intracranial lesion. Hence, early diagnosis may be essential not only to preserve sight but to save the patient's life.

If this is to be accomplished, the ophthalmologist must realize the importance of prompt neurologic consultation. Moreover, he should be aware of the value of angiographic studies when indicated.

The principle of angiography is the conversion, by the injection of a contrast medium, of the nonvisible blood of the vessels of the brain into radiopaque landmarks. Displacement of the vessels by a tumor is readily visible, and the vascular tree of the tumor itself may sometimes be outlined. Angiography is also of great ophthalmologic value in the diagnosis of vascular anomalies and of lesions involving the optic foramen. These will be presented in subsequent papers.

### NORMAL ANATOMY

In order to evaluate abnormalities in angiographic studies, it is essential to know the average course and the normal variations of the cerebral vessels. The brain is supplied by two arterial systems, the carotid and the vertebral basilar. These communicate with each other and with the arteries of the opposite side to form the circle of Willis. This irregularly shaped polygon situated at the base of the brain assumes particular importance to ophthalmologists because it encloses the optic chiasm.

As the internal carotid artery emerges from the cavernous sinus, it lies immediately behind the optic foramen, close to the inferior surface of the optic nerve. It forms a particularly important relation to the chiasm, lying close to its outer side and to that portion of the optic nerve extending from it (fig. 1).

The ophthalmic artery springs from the internal carotid just as that vessel is emerging from the cavernous sinus on the medial side of the anterior clinoid process. It passes forward and laterally below the optic nerve and through the optic foramen into the orbital cavity.

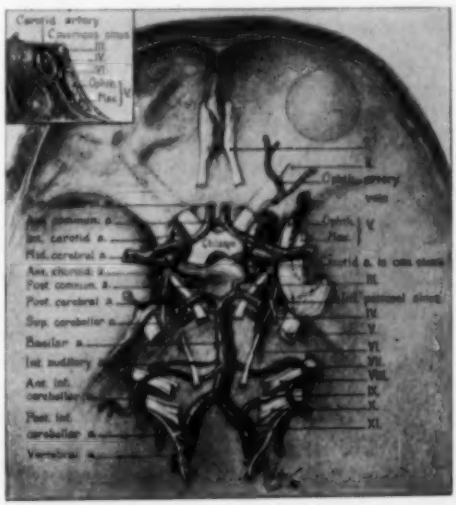


Fig. 1 (Joy, Ecker, and Reimenschneider). The typical relationship of the optic pathways to the cranial arteries at the base of the brain. (From Walsh, F. B.: *Clinical Neuro-Ophthalmology*, Baltimore, Williams and Wilkins, 1949.)

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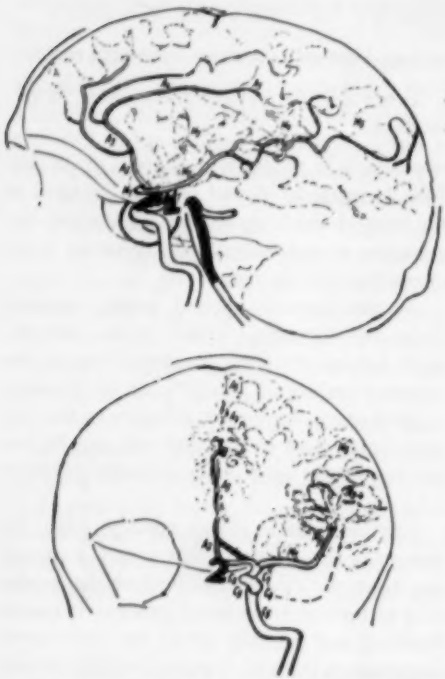

Fig. 2 (Joy, Ecker, and Reimenschneider). Diagrammatic drawing of the anatomy of the outstanding localizing arteries in carotid angiography. (C1-C5) Internal carotid artery. (A1-A5) Anterior cerebral artery. (M1-M5) Middle cerebral artery. Clear lines indicate normal course of vessels. Blacked lines indicate displacement caused by suprasellar lesion (2).

The posterior communicating artery arises from the internal carotid near its termination. It runs backward below and at right angles to the optic tract to join the posterior cerebral artery forming part of the circle of Willis. This artery often varies considerably in size on the two sides.

The internal carotid divides into two terminal branches, the anterior cerebral and middle cerebral arteries. The former, which is the smaller, passes forward and medially above and at right angles to the optic nerve just in front of the chiasm to the medial aspect of the hemisphere. Here it is connected with its fellow on the opposite side by the wide but short anterior communicating artery.

The basilar artery is formed by the junction of the two vertebral arteries. It commences at the lower border, and terminates at the upper border of the pons, bifurcating into the two posterior cerebral arteries. Each of these two arteries is connected with the internal carotid by the posterior communicating artery.

The outstanding localizing vessels in angiography of the carotid system are the internal carotid and the anterior and middle cerebral arteries. Their course is shown diagrammatically by the unblacked lines in Figure 2.

The internal carotid artery in the neck generally rises in a straight or curved line. It reaches the skull at the carotid foramen. Within the petrous bone, the artery passes anteromedially in a horizontal plane. At the region of the middle lacerated foramen, the artery rises vertically again (C5) and then passes forward opposite the sella turcica (C4). It then passes upward and medially within the dura (C3), emerging below and medial to the anterior clinoid process (C2). After entering the subarachnoid space the artery curves upward and laterally for 1.5 to 2 cm. (C1) to its bifurcation.

The middle cerebral artery proper (M1), which is only about 2.5 cm. in length, usually is the more direct continuation of the internal carotid. It passes laterally in the stem of the Sylvian fissure to the surface of the insula dividing into its two or three main terminal branches, the so-called Sylvian group, in the posterior part of the sulcus of Reil.

The first portion of the anterior cerebral artery (A1) passes anteromedially in a generally horizontal plane. When it reaches the midline it turns abruptly upward (A2). After being joined by the anterior communicating artery, the anterior cerebral arteries of the two sides pass backward close together to the parietal lobe.

Ordinarily, injection of the carotid artery with a contrast medium produces radiopaque visualization on that side only. How-

ever, if the contralateral carotid artery is compressed during injection, the substance may be perfused through the anterior communicating artery, offering visualization of the anterior and middle cerebral arteries of both sides.

Visualization of the vertebral-basilar system is of less ophthalmologic importance. This may be attained by injection of the vertebral artery directly. Also, it can frequently be accomplished indirectly by injection of the right carotid while compressing this artery above the point of the needle and at the same time obstructing the homolateral axillary artery by a tourniquet. This procedure tends to cut off the flow of the contrast medium beyond the points of compression, thus forcing it into the vertebral artery.

### Technique

Since both the carotid and vertebral-basilar systems can usually be made radiopaque by carotid injection, this method is used in routine cases. Both arteries and veins are perfused by the contrast medium, but arteriography furnishes the more valuable information to the ophthalmologist.

The X-ray appearance of the cerebral arteries depends on the aspect from which observed. The general overall picture is usually best obtained by anteroposterior, occipital, and stereoscopic lateral views, but this routine may be varied to meet the conditions of a particular case. As a rule, the arteries most closely associated with the visual pathways can best be observed by anteroposterior, lateral, and optic foramen arteriograms, after carotid injection.

Although angiography is not too formidable a procedure, the injection of foreign material into the cerebral vessels cannot be treated lightly. Hence, it is essential to use a contrast medium which not only will cast an adequate shadow but will also be as innocuous as possible.

No perfectly satisfactory substance has yet been discovered. But of those available, Diodrast (iodopyracet USP) appears to meet these requirements best.

Except in the presence of large arteriovenous aneurysms and in indirect vertebral angiography in adults, the concentration need not be greater than 35 percent. At this strength it can be injected in the average adult in amounts up to 120 cc. without ill effects.

Unlike some other contrast media it is safe to use with the percutaneous or closed method of arterial puncture, and it does not cause a serious reaction if a small amount is accidentally injected into the surrounding tissues. Moreover, the injection can be repeated in the same vessel or in other vessels of the neck.

Since some individuals are sensitive to Diodrast, it is essential that every patient be tested for sensitivity before any of the substance is injected. This is determined by noting the reaction of the conjunctiva 45 minutes after instilling one drop of 35-percent Diodrast into the conjunctival sac of one eye. The presence of congestion contraindicates its use in that patient.

Our procedure as used at Syracuse Memorial Hospital is briefly as follows:

After preliminary basal sedation and sensitivity tests for Diodrast, the patient is placed on his back on the X-ray table while preliminary films are made to check his position and to act as controls for the angiograms.

Under local anesthesia, 15 cc. of warm Diodrast is injected into the carotid artery while the assistant angiographer is compressing the contralateral carotid. If any difficulty is encountered, the common carotid is exposed by a small incision low in the neck.

Exposure for the arteriogram is made while completing the injection. Then the compression of the contralateral carotid artery is released and within 5.5 to 6.0 seconds another exposure is made for the venogram. The needle is left in the artery and the procedure repeated for each view desired.

If indirect angiographic films of the vertebral system are to be made, pressure is exerted on the homolateral right carotid artery just above the point of the needle and the axillary artery on the same side is compressed by a tourniquet while the Diodrast is being injected.

In routine practice a total amount of 60 cc. or more of 35-percent Diodrast is injected into the cerebral vessels. As a rule, there is very little reaction, serious complications seldom occur, and generally the patient leaves the hospital the following day.

### Anteroposterior view

Anteroposterior arteriograms are of greatest value in the diagnosis of lesions displacing the internal carotid and the first portions of the anterior and middle cerebral arteries.

In anteroposterior projections (fig. 3), the internal carotid as it passes the sella turcica resembles an aneurysm (C4). The origin of the ophthalmic artery is overshadowed by the internal carotid but it appears clearly within the orbit. The bifurcation of the internal carotid is well projected.

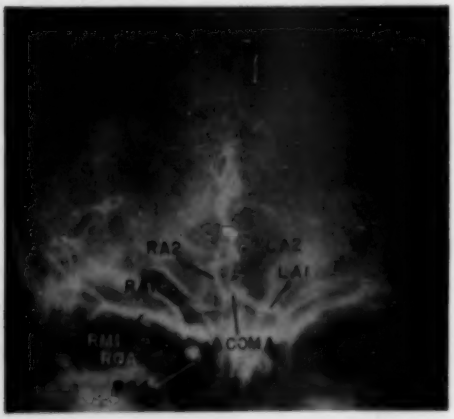


Fig. 3 (Joy, Ecker, and Reimenschneider). Normal anteroposterior arteriogram. Right carotid injection with compression of left carotid. (RC4) Right internal carotid artery as it passes sella turcica. (ROA) Right ophthalmic artery. (RMI) First portion right middle cerebral artery. (RAI and LAI) First portion right and left anterior cerebral arteries. (RA2 and LA2) Second portion right and left anterior cerebral arteries. (A COM A) Anterior communicating artery.

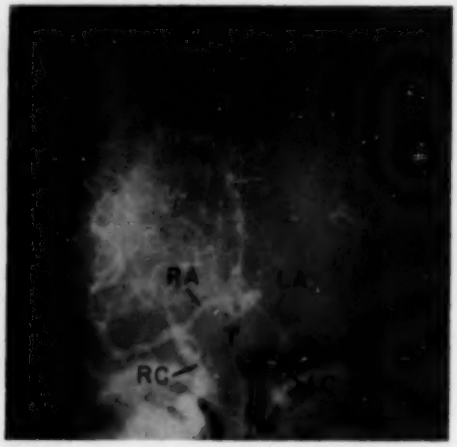


Fig. 4 (Joy, Ecker, and Reimenschneider). *Case S. N.* Anteroposterior view, right carotid arteriogram with compression of left carotid. Suprasellar extension of chromophobe adenoma of pituitary has caused bilateral upward archlike displacement of first portion of anterior cerebral arteries (RA and LA) and lateral and upward displacement of carotid bifurcation bilaterally. (RC and LC) Right and left internal carotid arteries. (T) Indicates site of tumor.

Usually the middle cerebral artery appears as a direct continuation of the parent stem. Only the first portion (M1) of this vessel is projected in its true plane because its subsequent course progresses upward and backward.

Since the first portion of the anterior cerebral artery (A1) proceeds anteromedially in a generally horizontal plane, anteroposterior views offer excellent visualization of any discrepancies in its course. They also demonstrate the considerable difference in size often normally present on the two sides. This difference is best shown after contralateral carotid compression.

Anteroposterior anteriograms show only lateral displacements of the ascending or vertical portion of the anterior cerebral artery. This vessel frequently undulates from side to side in almost equal degree. A pathologic displacement causes a gentle curve whereas normal swings are somewhat jagged.

The exact status of the anterior communi-

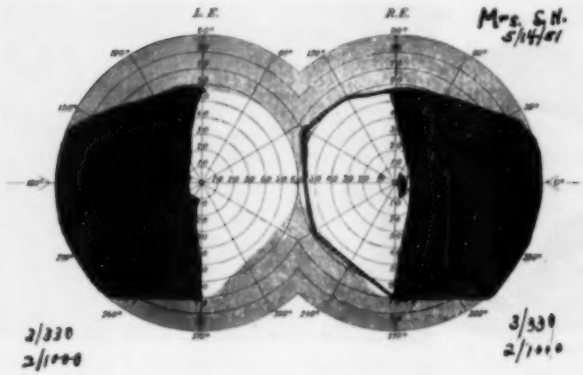


Fig. 5 (Joy, Ecker, and Reimenschneider). *Case S. N.* Almost complete bitemporal contraction of peripheral fields and paracentral scotoma of right eye.

cating artery is best seen after contralateral carotid compression. This artery varies greatly in appearance. It may be doubled or it may be absent. In the latter case the first part of the vertical portion of each anterior cerebral artery (A2) may be fused.

Space-occupying lesions extending upward out of the sella turcica or originating in the suprasellar area have a profound effect on the vessels of the circle of Willis. Hence, they lend themselves readily to angiographic study. Tumors in this region first tend to displace the anterior cerebral artery, and later, if they become large enough, to displace the terminal portion of the internal carotid (fig. 2).

### Demonstration of tumors

Anteroposterior views are helpful in detecting small tumors by disclosing elevation of the first portion of the anterior cerebral artery. As the tumor increases in size, this section of the artery may be seen displaced upward to form a concave arch directly overlying the mass. If the tumor becomes sufficiently large, the terminal portion of the internal carotid is likewise elevated and at the same time displaced laterally.

This is demonstrated in a case of chromaphobe adenoma of the pituitary with suprasellar extension. The anteroposterior view with bilateral filling of the carotid system shows a marked upward archlike displacement of both anterior cerebral arteries, and lateral displacement and elevation of the terminal portions of both internal carotids (fig. 4).

This 64-year-old woman's only complaint was failing sight over a period of several years. Corrected vision was 20/200 in the right eye and 20/50 in the left eye. With the exception of almost complete bitemporal contraction of the peripheral fields and a paracentral scotoma of the right eye, the ophthalmologic examination revealed no significant defects (fig. 5).

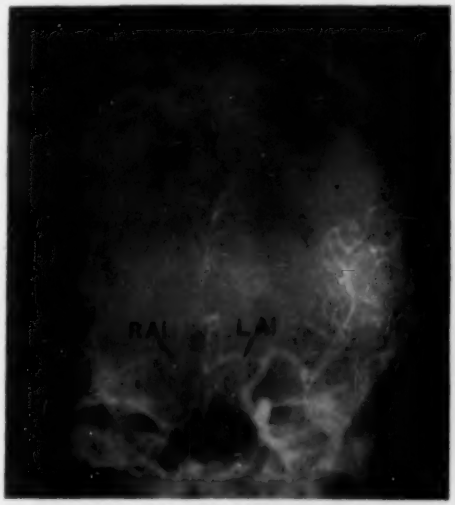


Fig. 6 (Joy, Ecker, and Reimenschneider). *Case F. B.* Anteroposterior view, left carotid arteriogram with right carotid compression. Upward displacement and stretching of first portion of anterior cerebral arteries (RAI and LAI) less marked than in Case S. N. Tumor was situated more posteriorly.

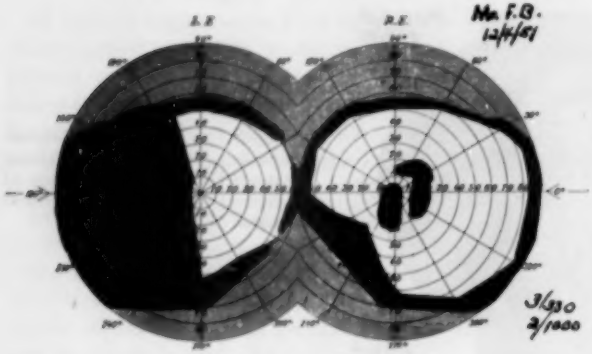


Fig. 7 (Joy, Ecker, and Reimenschneider). Visual fields in *Case F. B.* suggest a postchiasmal lesion. Loss of temporal half of left field and lower nasal quadrant defect of right field. Central scotoma and one extending from blindspot in right eye.

The degree of displacement of the anterior cerebral arteries does not necessarily indicate the size of the tumor. This may be due either to the site of its origin or the direction of its growth. Such a discrepancy is demonstrated in the arteriogram of a patient with a craniopharyngioma which was fully as large as the tumor in the preceding case. Yet, since the tumor was situated more posteriorly, it had displaced the anterior cerebral arteries very much less (fig. 6).

In this 52-year-old man the symptoms were entirely visual. Neurologic examination disclosed no abnormalities and plain skull films showed only a shallow sella. The patient had noted failing vision in the right eye and inability to see objects to the left side for about one year.

Corrected visual acuity was 20/60 in the right eye and 20/50— in the left eye. The ocular fundi were normal. The perimetric findings indicated a postchiasmal lesion since there was loss of the temporal half of the left field and a lower nasal quadrant defect of the right field. There was also a central scotoma and one extending from the blindspot in the right eye (fig. 7).

Meningiomas arising from the tuberculum sellae or the sulcus chiasmatis represent one of the more frequent and hopeful types of tumors in this region. If discovered early, they can usually be removed without fear of recurrence, and even if extirpation is not complete, subsequent regrowth is ordinarily quite slow.

They are of particular concern to the ophthalmologist because the first signs, and often until very late the only signs, are in his domain. As a rule, subjective symptoms are not constant, helpful neurologic findings are rarely present, and plain skull films show little or no bone changes. Fortunately, they lend themselves particularly well to angiographic study.

Meningiomas, which are typically supra-

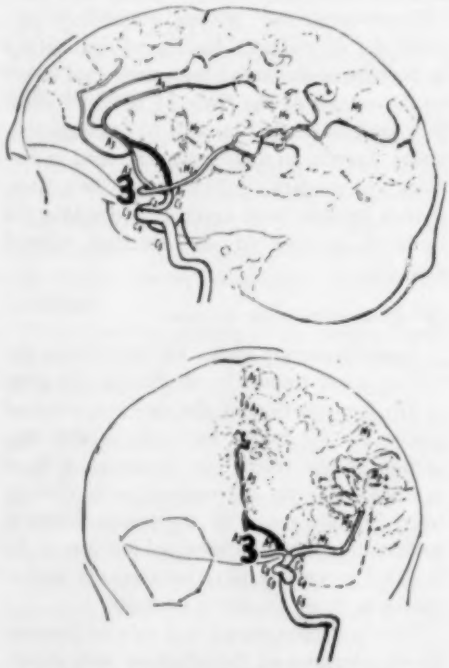


Fig. 8 (Joy, Ecker, and Reimenschneider). Diagrammatic drawing showing location of prechiasmal lesion (3) and consequent displacement of anterior cerebral artery. Clear lines indicate normal course. Blacked lines indicate displacement.

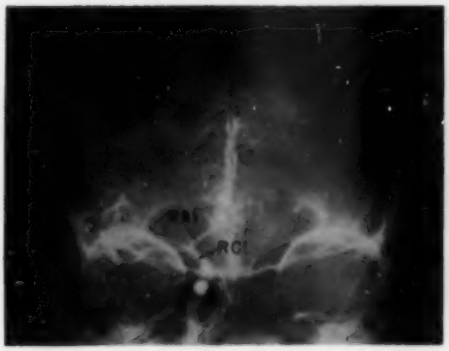


Fig. 9 (Joy, Ecker, and Reimenschneider). *Case T. H.* Anteroposterior view, right carotid arteriogram without contralateral carotid compression. Upward displacement and stretching of first portion of right anterior cerebral artery (RAI). Elevation and slight lateral displacement of carotid bifurcation. (RCI) Terminal portion internal carotid artery.

sellar, exert pressure on the chiasm tending to produce bitemporal field defects and the picture of primary optic atrophy. However, these tumors may primarily involve the prechiasmal portions of the visual pathway rather than the chiasm itself.

This causes quite a different ophthalmologic picture. For in prechiasmal cases, the visual function of the two eyes is attacked successively rather than simultaneously. As a consequence, vision in one eye may be seriously impaired while the other eye remains normal or nearly so. Then after a variable period, extending to weeks or months or more, the second eye becomes affected.

The field defects in these cases are usually bizarre, and consist of a combination of central and peripheral involvement. One of the characteristics is the rapid development of central scotomas which may on occasion simulate retrobulbar neuritis.

Since presellar masses lie further forward than suprasellar tumors, the points of maximum pressure likewise lie further forward. Hence, there is less change in the carotid and more displacement of the anterior cerebral arteries (fig. 8).

Anteroposterior arteriograms usually demonstrate bilateral and symmetrical elevation of the first portion of the anterior cerebral arteries. Since these masses lie in front of the sella, the bifurcation of the internal carotid tends to be forced upward and backward in contradistinction to the predominantly lateral displacement seen with suprasellar masses.

This is shown in the right arteriogram of a 62-year-old woman with a presellar meningioma (fig. 9). There is marked upward displacement and stretching of the first portion of the anterior cerebral artery along with elevation and slightly lateral displacement of the carotid bifurcation.

This patient had had sudden loss of vision in the left eye, followed over two years later by progressive temporal and central field defects in the right eye with consequent visual reduction to 4/200 (fig. 10). The left optic disc presented the picture of complete primary optic atrophy. The right disc was suspiciously pale. No other signs or symptoms were ever present, and plain skull films failed to disclose any significant abnormalities. Partial removal of the meningioma was followed by full restoration of visual function of the right eye which has been maintained up to the present, a matter of over three years.

Unfortunately, many cases are not subjected to angiographic study until the tumor has become too far advanced for removal.

An example of such a delay is a 46-year-old man who suddenly discovered impaired vision in his left

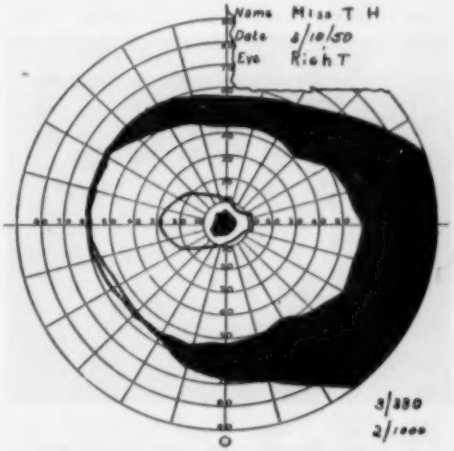


Fig. 10 (Joy, Ecker, and Reimenschneider). *Case T. H.* Visual field of right eye showing temporal contraction and pericentral scotoma.

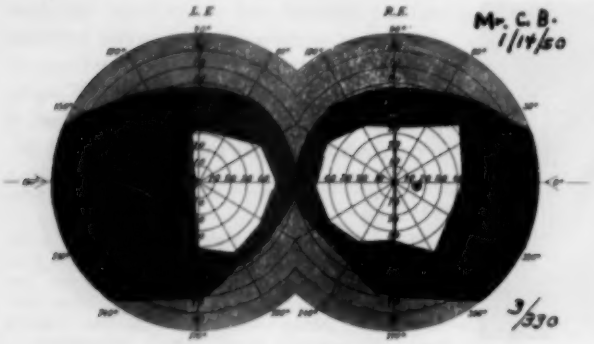


Fig. 11 (Joy, Ecker, and Reimenschneider). *Case C. B.* Visual fields showing bitemporal hemianopia, incomplete in right eye.

eye seven years previous to our examination. The right eye was apparently unaffected until six years later when he noted a defect in its temporal visual field.

When first seen by us, vision in the right eye was 20/20 and in the left eye 3/100. Ophthalmologic examination revealed bitemporal hemianopia which was incomplete in the right eye (fig. 11) and the picture of primary optic atrophy which was more advanced in the left eye.

The arteriogram shows bilateral upward stretching of the first portion of the anterior cerebral arteries with lateral displacement of the carotid bifurcation (fig. 12). At operation a large unremovable meningioma of the tuberculum sellae was found.

Obviously, it is not possible to classify rigidly the position of all tumors in this region, since regardless of its origin the growth may extend in any direction. Moreover, angiography on occasion may be misleading, particularly in the differential diagnosis of types of tumors.

Such occurred in a case in which venograms displayed visible capillary filling of a mass which suggested the presence of a meningioma. The arteriogram (fig. 13) shows bilateral upward displacement and stretching of the first portion of the anterior cerebral arteries. Plain skull films disclosed only slight flattening of the sella.

This patient gave a history of sudden bilateral blindness five months after the onset of bitemporal hemianopia with partial preservation of the inferior temporal fields.

When first examined by us, vision in the right eye was 20/100 and in the left eye 20/200. Both optic discs were pale and the nasal margins slightly blurred. There was bitemporal hemianopia, and, in the left eye, contraction of the interior and nasal fields as well (fig. 14).

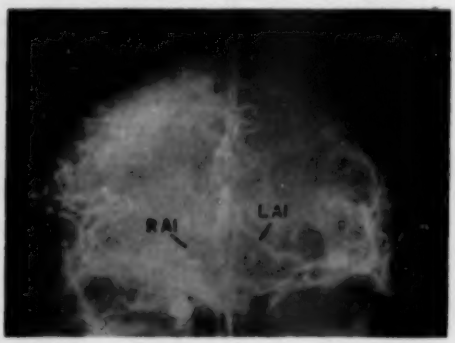


Fig. 12 (Joy, Ecker, and Reimenschneider). *Case C. B.* Anteroposterior view, right carotid arteriogram with compression of left carotid. Bilateral upward stretching of first portion of anterior cerebral arteries (RAI and LAI). Lateral displacement of carotid bifurcations.

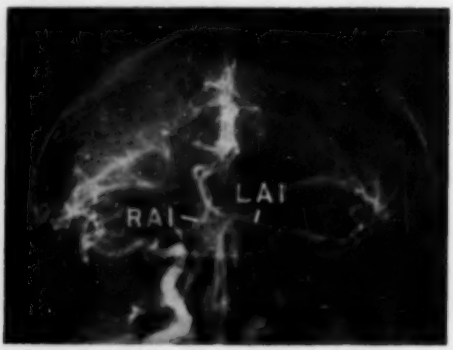


Fig. 13 (Joy, Ecker, and Reimenschneider) *Case O. T.* Anteroposterior view, right carotid arteriogram with compression of left carotid. Bilateral upward displacement and stretching of first portion of the anterior cerebral arteries (RAI and LAI).

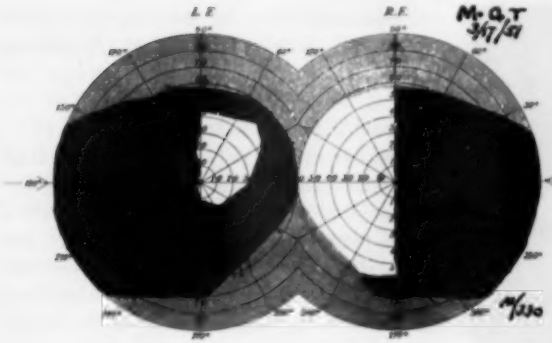

Fig. 14 (Joy, Ecker, and Reimenschneider). *Case O. T.* Visual fields showing bitemporal hemianopia. Also contraction of inferior and nasal fields of left eye.

Craniotomy revealed a mass bulging out of the sella turcica anterior to the chiasm which was apparently post fixed. The tumor which bled freely was found to be a chromophobe adenoma of the pituitary.

### Lateral view

In lateral arteriograms, the internal carotid artery appears as an S-shaped structure (fig. 15). It obscures the origin of the ophthalmic artery, but as this vessel proceeds anteriorly it can be seen in the orbit in about 80 percent of lateral films.

The posterior communicating artery is observable in about one third of carotid injections. It is useful as an indicator of either upward or downward transtentorial dislocation of the brainstem.

The normal bifurcation of the internal carotid artery projects poorly in lateral films; that is, there is overlapping of the early course of its terminal branches.

The horizontal portion of the anterior cerebral artery is greatly foreshortened. After it is joined with the anterior communicating artery, it can be seen to curve abruptly and ascend in its vertical course.

Although the first portion of the middle cerebral artery is projected on-end its subsequent course is well visualized, and its main terminal branches, the Sylvian group, are usually the outstanding vessels seen in lateral arteriograms.

Up to the present, little attention has been paid to the orbital portion of the ophthalmic artery in angiography. Few of its branches can be definitely identified, and because of its tortuous variable course its displacement by space-occupying orbital lesions is difficult to detect.

A few months ago, however, Schurr[1] published results of angiographic studies which may be of far-reaching importance to ophthalmology. In lateral angiograms after carotid injection he was able to demonstrate, in 10 of the 17 normal films examined, a thin crescent of opacity in the outer two thirds of the orbit. This crescent, which he identified as the venous channels of the choroidal plexus, formed from above downward as the shadow of the ophthalmic artery faded out.

Schurr suggested that apart from the obvious application of the method to the depic-

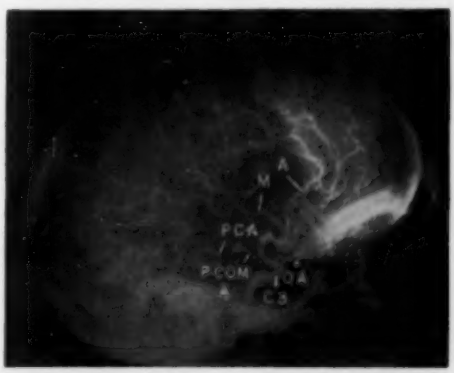


Fig. 15 (Joy, Ecker, and Reimenschneider). Normal lateral arteriogram with carotid injection. (C3) Third portion internal carotid artery. (OA) Ophthalmic artery. (P Com A) Posterior communicating artery. (PCA) Posterior cerebral artery. (M) Middle cerebral artery and its branches. (A) Anterior cerebral artery.


Fig. 16 (Joy, Ecker, and Reimenschneider). *Case S. N.* Lateral view, right carotid arteriogram. Posterior and upward convexity of first and second portions of anterior cerebral artery (A1 and A2). Upward displacement of terminal portion of internal carotid (C).

tion of vascular abnormalities, it is possible that a technique might be developed which which would also facilitate the demonstration and differential diagnosis of orbital and ocular neoplasms. We would expect that it would be of especial value in the diagnosis of posterior intraocular tumors and intraorbital vascular lesions, particularly arterial aneurysms and arteriovenous malformations.

### Demonstration of tumors

Lateral arteriograms are of great value in the diagnosis of tumors originating in the sellar region, since vertical and anteroposterior displacement of the second and third portions of the anterior cerebral arteries, as well as the internal carotid, are well visualized.

Suprasellar growths tend to cause a posterior upward convexity of the second portion of the anterior cerebral artery, and, if sufficiently large, distortion of the terminal portion of the internal carotid. This is demonstrated in the case of pituitary tumor with suprasellar extension in which the anteroposterior view was shown (fig. 16).

This is also seen in the case of craniopharyngioma. The size of the tumor is better visualized than in the anteroposterior arteriogram of this patient. Not only is there marked opening of the carotid syphon but there is also tremendous stretching of the posterior communicating artery (fig. 17).

Presellar tumors or presellar extension of suprasellar masses tend to cause a more exaggerated convexity of the anterior cerebral artery than is the case of those which are purely suprasellar. The displacement extends higher and further forward, involving both the second and third portions of the artery (fig. 8).

This distinction may give a clue as to the origin and size of the tumor. This is shown in the lateral view of the cases of meningioma.

In the first patient, the tumor mass, in which the intrinsic circulation is visible, has also elevated the terminal portion of the internal carotid artery (fig. 18). In the second case, since the tumor was larger, there is greater elevation and posterior displacement of the second and third portions of the anterior cerebral (fig. 19). The original films revealed abnormal vessels above the region of the tuberculum.

The displacement of the third portion of this artery is even more exaggerated in the case of chromaphobe adenoma (fig. 20). This, together with evidence of capillary filling of


Fig. 17 (Joy, Ecker, and Reimenschneider). *Case F. B.* Lateral view, right carotid arteriogram. Opening of carotid syphon. Tremendous stretching of posterior communicating artery (P COM A) which has filled posterior cerebral artery (PCA).

the underlying mass, led to the mistaken diagnosis of presellar meningioma.

### Complications

The development of a sound technique, together with experience, minimizes the occurrence of ill effects from angiography. However, 35-percent Diodrast has an osmotic tension three and one-half times that of normal human plasma. It is probable that this hypertonicity may account for at least some of the side effects and occasional severe complications associated with this procedure.

The mechanism seems to be immediate temporary vasoconstriction followed by more prolonged vasodilatation and increase in permeability of craniocerebral capillaries.

Carotid arterial injection of 35-percent Diodrast causes a temporary burning pain in the area supplied by the vessels, as well as slight discomfort lasting about 24 hours at the site of the injection. There may be momentary homolateral pallor followed by flushing of the skin of the face as the contrast medium permeates the external carotid system. Pain in and about the eye on the injected side is associated with filling of the internal carotid system. The presence of burning pain both in the face and behind the eye provides evidence that both systems have filled.

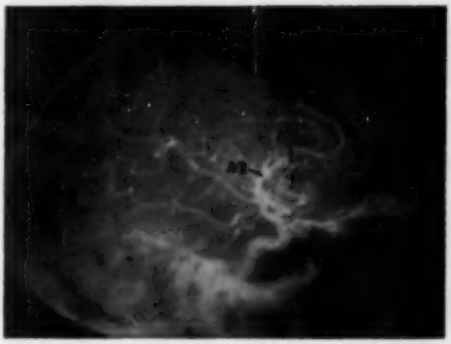

Fig. 19 (Joy, Ecker, and Reimenschneider). *Case C. B.* Lateral view, right carotid arteriogram. Upward and backward displacement of second and third portions of anterior cerebral artery (A2 and A3) is greater than in Case T. H. (T) Indicates tumor.

According to Schurr,[1] the patient often describes a flash of light as the injection is being made. He has attributed this to retinal irritation by the contrast medium. He has reported a momentary narrowing of the retinal vessels followed by dilatation. Any such constriction must usually be of low degree since it is rarely observable with the

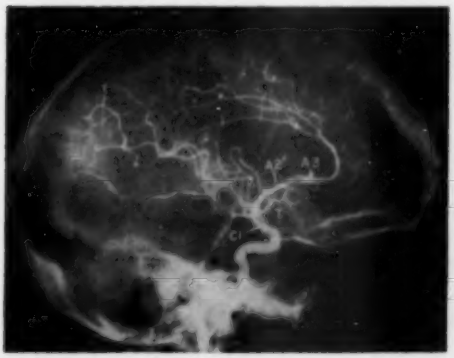

Fig. 18 (Joy, Ecker, and Reimenschneider). *Case T. H.* Lateral view, right carotid arteriogram. Upward and backward displacement of second and third portions of anterior cerebral artery (A2 and A3). Elevation of terminal portion of internal carotid (C1). Suggestion of intrinsic circulation in tumor (T).

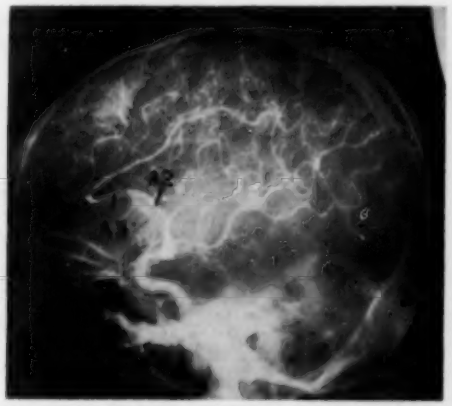

Fig. 20 (Joy, Ecker, and Reimenschneider). *Case O. T.* Lateral view, left carotid arteriogram. Displacement of third portion of anterior cerebral artery (A3) is even more exaggerated than in Case C. B.

ophthalmoscope, and patients seldom complain of blurred vision.

Vomiting, or more rarely short convulsive seizures or a slight fever, may be associated with the injection of the contrast medium. More serious complications such as hemiplegia and respiratory embarrassment rarely occur. As a rule, the hemiplegia is transitory, and the respiratory difficulties are amenable to emergency measures. However, in some isolated cases death has ensued.

Nevertheless, serious complications are uncommon, and the possibility of their occurrence is counterbalanced by the valuable information obtained by the use of angiography when indicated. In general the greater the experience the fewer the complications.

With the exception of dilatation of the pupil and reddening of the conjunctiva on the injected side, ocular complications or side effects have not in our experience been a prominent feature. The mydriasis, which is possibly caused by stimulation of the sympathetic fibers, begins during the injection. It is usually transitory but occasionally may persist for several hours.

Falls, Bassett, and Lamberts[2] in a study of 80 consecutive angiographies encountered ocular side effects or complications in 86.3 percent of the patients.

Conjunctival petechias, especially in the fornices, were almost a constant feature (81.3 percent). They could be visualized almost immediately after injection in some cases. In others the hemorrhages were not observable until 30 to 90 minutes later.

Retinal hemorrhages were encountered in 25 percent of their patients. They were mostly confined to the posterior pole, and were generally round, granular, and in a few instances preretinal. Many of the hemorrhages presented white centers and were frequently accompanied by cotton-wool exudates.

The authors suggested that the petechial changes in the conjunctiva and retina might have been brought about by prestatis hyperemia induced by the injection of the contrast medium.

We agree with Walsh[3] that the percentage figures presented by Falls and his coworkers seem much higher than we have encountered. However, like him we have not made a comparable statistical study. This we are in the process of doing.

We have observed only two cases with petechias in 500 angiographies. In the first patient there was transitory contralateral hemiplegia. The second patient exhibited no neurologic signs.

Complications related to visual disturbance are rarely encountered. So far, we have observed none. In the few cases reported, the visual loss was almost always transitory and confined to the side of the injection. In was usually attributed to an embolism or to arterial spasm, but in most cases the eyes were not examined during the period of blindness and consequently the mechanism could not be definitely determined.

In Weekers'[4] case there was a convulsive seizure immediately after injection. This was followed by hemiplegia of brief duration. The following day a superior nasal quadrant field defect, which remained permanently, was found in the homolateral eye. Ophthalmoscopic examination revealed a large zone of whitish edema in the submacular region. Weekers presumed that it was caused by a solid embolism.

Curtis[5] described a case of focal seizure on the contralateral side and brief loss of consciousness shortly after injection. Visual impairment of the homolateral eye was noted later in the same day. Ophthalmologic examination two days after the injection showed spasm of the retinal arterioles and a central scotoma which did not resolve.

Falls, Basset, and Lamberts[2] encountered three patients with visual defects which they attributed to cerebral angiography. In two patients, the duration of visual loss was brief (10 to 30 minutes). Although neither patient's fundus was studied during this period the cause was interpreted to be vasospastic in nature. The third patient suffered severe optic neuritis with eventual complete loss of vision.

Otenasek and Markham[6] reported a case of homolateral visual reduction with complete recovery in 48 hours. In this patient, in which the contrast medium only permeated the external carotid system, blurred vision was noted within two hours.

Vision was reduced to counting fingers at one foot, and the macula appeared reddened and indistinct. There was a large central scotoma and the peripheral field was constricted, especially nasally.

Vision did not improve until after a stellate block six hours later. This was repeated after another 16 hours, and no residual defect was present 48 hours after the onset.

Arteriograms did not demonstrate thrombosis of the internal carotid absolutely. The authors considered the possibility of the congenital absence of this vessel.

The mechanism of visual failure was not clear. In view of the fundus picture and complete recovery of vision, embolism or thrombosis of the central retinal artery could be excluded. On the other hand, the authors expressed the belief that spasm might possibly have been the cause.

Walsh and Smith[3] encountered three cases of visual impairment following approximately 1,200 angiograms. In two patients there was temporary loss of vision of the homolateral eye starting several hours after injection. Although it could not be definitely determined if the injection was responsible, the cause was assumed to be either retinal arterial spasm or an embolism.

The third case represented a complication not previously reported. In this patient complete bilateral blindness occurred within one minute after injection. There was recovery of light perception after stellate blocks made within 20 minutes. Ten hours later the right homonymous half fields had improved. The next day the right fields were normal, and 36 hours after the onset both fields were full and visual acuity was normal in each eye.

The authors considered that the visual disturbance might have been dependent on contralateral compression of the carotid artery used to obtain bilateral filling of the internal carotid system. They reasoned that there was an apparent temporary interference with the blood supply to the visual pathways above the level of the geniculate bodies and pregeniculate gray matter.

Seemingly, the retinas were not rendered ischemic, probably because of the liberal collateral circulation from the external carotid system to the ophthalmic arteries. It was assumed that in this patient the posterior cerebral arteries arose directly from the internal carotid artery of each side.

Based on the few cases of visual disturbance which have been reported, it is apparent that in this respect angiography offers little danger, and almost none regarding permanent visual loss.

## Conclusions

The presence of an unexplained visual defect should always suggest the possibility of an intracranial lesion. Ophthalmologic examination may yield the first clinical sign of a pituitary tumor, aneurysm, or meningioma of the base of the skull.

Since not only vision but life itself may be at stake, early diagnosis is essential. This may be extremely difficult at this stage, for helpful neurologic findings are rarely present and plain skull films may show little or no bone changes.

In such cases the close relationship of the visual pathways to the arteries at the base of the brain assumes particular importance. In this congested area even a small lesion impinging on the pathways tends to displace the adjacent arteries. Their conversion into radiopaque landmarks by the injection of a contrast medium provides visualization of the displacement, and sometimes of the vascular tree of the mass itself.

Hence, suprasellar and presellar tumors lend themselves readily to angiographic study. A distinct advantage of angiography over other diagnostic methods is the frequent ability to demonstrate at an earlier stage the location and sometimes the character of the lesion.

Certain minor side effects caused by the procedure occur with more or less frequency, but in competent hands serious complications seldom follow, and death ensues only occasionally.

Complications related to visual disturbance are rarely encountered. The visual defect is almost always transitory and confined to the side of the injection. So far, the literature reveals two patients with permanent field defects and one with total visual loss.

Any danger associated with angiography is compensated for by the valuable information obtained by its use when indicated.

In the angiographic study of intracranial lesions the ophthalmologist and the neurologist met on common ground, and there should be close co-operation between them throughout the progress of the case.

*504 State Tower Building.*

Figures 2, 4, 6, 8, 12, 13, 16, 17, 19, and 20 are reproduced through the courtesy of Charles C Thomas, Springfield, Illinois, and will appear in Ecker, A. D., and Reimenschneider, P. A.: *The Angiographic Localization of Intracranial Masses*, 1953.


REFERENCES

1. Schurr, P. H.: Brit. J. Ophth., **35**:473 (Aug.) 1951.
2. Falls, H. F., Bassett, R. C., and Lamberts, A. E.: Arch. Ophth., **45**:623, 1951.
3. Walsh, F. B., and Smith, G. W.: J. Neurosurg., **9**:517, 1952.
4. Weekers, R.: Ann. d'ocul., **182**:926, 1949.
5. Curtis, J. B.: Brit. J. Surg., **38**:295, 1951.
6. Otenasek, F. J., and Markham, J.: J. Neurosurg., **9**:547, 1952.


# RETROLENTAL FIBROPLASIA*


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## MATERIAL AND METHODS

In this study, 105 infants were observed in the premature nursery of Mount Sinai Hospital, Chicago. The study was started in October, 1951, and included the infants born during December, 1952. Twenty immature infants are included in this group for comparative purposes. We classify as immature an infant of normal 40 weeks' gestation but whose birth weight is less than five pounds.

Those who investigate premature babies come to realize that they react differently from those born at normal 40 weeks' gestation. Their development is subnormal in all respects; they do not cry, hardly whimper. Their respirations are uneven; there seem to be periods of apnea, followed by a series of rapid shallow abdominal respiratory movements; it is not possible to count the respiratory rate. Some who are 13 to 10 weeks' premature cannot be removed from the incubator for even the shortest period of time because their respirations stop completely.

Feeding must be done by gavage, as the infants are unable to swallow even when fed by means of an eyedropper. Thus, not only the visual muscular development is subnormal, but apparently all the organs of the body are similarly subnormal and would require anywhere from five to 13 more weeks of intrauterine life for further development.

Feeding in the nursery is based on the body-weight fluid intake—one twelfth of the body weight of milk and water is given by the fourth, fifth, or sixth day; thereafter, one twelfth of the body weight of milk plus the same amount of water as was previously

* From the Department of Ophthalmology, Mount Sinai Hospital. Presented before the Chicago Ophthalmological Society, November 16, 1953.

In the September, 1953, issue of the *British Journal of Ophthalmology*, Ashton states that, in his experiments with kittens, he found that high concentrations of oxygen (60 to 80 percent) will cause the obliteration of the formative vessels of the retina and that mature vessels are not affected.

given. Thus, the amount of milk is gradually increased to one sixth of the body weight (on an individual basis) within 10 days to two weeks or one month of age, as tolerated. The premature of one pound 12 ounces to three pounds in weight may take 60 days to reach an intake of one sixth of the body weight in milk.

All babies at first receive breast milk; later Similac with casein is added. Water-soluble Tri-Vi-Sol (Meade's) is started in all cases on the sixth day beginning with two minims and increased daily up to the 10th day when 10 minims is reached. Each unit of 10 mm. Tri-Vi-Sol contains 2,500 units of vitamin A, 500 units of vitamin D, and 25 units of vitamin C (ascorbic acid 25 mg.). Additional vitamin C is given if needed. No iron is given; 75,000 units of penicillin are given daily for several weeks.

The Beck type of incubators are used. The oxygen flow is regulated to two liters per minute. The percentage of oxygen in the incubator can be regulated, and this has been checked on many occasions and found to be consistently reliable.

The temperature in the incubator is also regulated at will and this, too, is done on an individual basis. Here again the prematures differ from the normal. They do not maintain their normal temperature as does an infant of normal gestation, but the temperature may fall considerably below normal, even as low as 95 to 96°F., and, therefore, the temperature within the incubator has to be varied accordingly.

Most of the infants in this group were born in Mount Sinai Hospital; others were brought in by the Health Department from other hospitals. They are examined every week while in the nursery. After discharge from the hospital, the pediatrician in charge was contacted and requested to have the eyes examined by an ophthalmologist, from whom I received the follow-up report. Service cases were followed by our own eye clinic.

In this group of 105 cases there were 50 males and 55 females. The prematurity ranged from one to 13 weeks. Nine of the infants developed retrolental fibroplasia, the process going to completion.

### Classification used

I utilized the following classification of the stages of retrolental fibroplasia; this is somewhat modified from the Reese-Blodi classification:

Stage I. Dilatation of the retinal vessels with or without tortuosity.

Stage II. Stage I plus hemorrhage or retinal edema.

Stage III. Stage II plus neovascularization.

Stage IV. Stage III plus partial retinal detachment.

Stage V. Complete detachment—no red reflex.

Haziness of the vitreous should be added to the early signs of retrolental fibroplasia. In this series, I have found no regression of the process after it has reached Stage III. Whenever there was dilatation, tortuosity, hemorrhage, or edema plus neovascularization, the process as a rule went to completion.

The pathologic findings which have been so ably described by Reese and Blodi have been generally accepted. The histologic changes consist of nests of endothelial cells and glial proliferation in the equatorial area of the nerve-fiber layer of the retina. The endothelial-cell proliferation is followed by canalization and breaking through the internal limiting membrane, hemorrhage and edema resulting from the newly formed vessels. The masses of angiomatous tissue creep between the retina and the hyaloid membrane of the vitreous, and then invade the vitreous. Involvement of the greater part of the retina follows, with detachment and contracture.

The general procedure in our nursery is to discharge the infant after it has reached the weight of 5.5 pounds. The length of stay in the hospital according to the birth weight is shown in Table 1.

TABLE 1

LENGTH OF STAY IN HOSPITAL ACCORDING TO BIRTH WEIGHT

| Birth Weight in Pounds | Days in Nursery |
|---|---|
| 2 to 2.5 | 33 to 78 |
| 2.5 to 3 | 40 to 58 |
| 3 to 3.5 | 21 to 41 |
| 3.5 to 4 | 22 to 38 |
| 4 to 4.5 | 10 to 14 |
| 4.5 to 5 | 10 to 16 |

As a general rule, the birth weight was found to compare favorably with prematurity; however, a certain number of discrepancies occur. It is important to point out these discrepancies, since some investigators have described the occurrence of retrolental fibroplasia according to the various weight groups. King,[1] in his study of 238 cases, found that 85 percent weighed less than four pounds at birth; 44.2 percent weighed less than three pounds; and 15 percent weighed from four to five pounds. These data are in agreement with those reported by Kinsey and Zacharias,[2] Owens and Owens,[3] and Unsworth.[4]

Table 2 shows the birth weight and gestation period of the so-called "regular" group, that is, the group of infants who show a normal relationship of weight and gestation period.

Table 3 shows a group of prematures of similar gestation as those in the regular group, but in whom the birth weight is not in agreement with the gestation period.

TABLE 2

REGULAR GROUP—27 TO 32 WEEKS' GESTATION

| Case Number | Gestation Weeks | Birth Weight Lb. | Oz. |
|---|---|---|---|
| 78 | 27 | 2 | 7 |
| 32 | 28 | 2 | 1 |
| 50 | 29 | 2 | 8 |
| 90 | 30 | 2 | 7 |
| 46 | 31 | 2 | 8 |
| 38 | 31 | 3 | 1 |
| 76 | 31 | 3 | 1 |
| 94 | 31 | 3 | 12.5 |
| 28 | 32 | 3 | 15 |
| 80 | 32 | 3 | 14 |

TABLE 3

GROUP OF 27 TO 32 WEEKS' GESTATION

| Case Number | Gestation Weeks | Birth Weight Lb. | Oz. |
|---|---|---|---|
| 23 | 28 | 4 | 4 |
| 40 | 28 | 3 | 11¾ |
| 41 | 28 | 4 | 7¾ |
| 7 | 28 | 3 | 13 |
| 92 | 30 | 3 | 4¾ |
| 48 | 31 | 4 | 10 |
| 73 | 31 | 4 | 2¾ |
| 95 | 32 | 4 | 0 |
| 63 | 32 | 5 | 2 |

Thus it can be seen that when the occurrence of retolental fibroplasia is based on the birth weight of the infants, it does not always agree with the gestation period.

In Table 4 similar discrepancies in the gestation period and birth weight of the older group are shown.

When the infant reaches 5.5 pounds in weight, it is, as a rule, sent home. The need for the incubators for new arrivals makes it imperative to discharge infants when they reach this weight. As will be seen from Table 5, although these infants have reached the required weight, from the standpoint of gestation they are still premature at the time of discharge. Many of them, indeed, are from two to seven weeks premature at the time when they are discharged from the nursery.

Table 6 shows that infants who developed retrolental fibroplasia were premature from one and one-half to six and one-half weeks at the time of discharge.

Three of the group of nine who developed retrolental fibroplasia were born within a period of one month (table 7), two being

TABLE 4

OLDER GROUP—GESTATION AND BODY WEIGHT

| Case Number | Gestation Weeks | Birth Weight Lb. | Oz. |
|---|---|---|---|
| 9 | Immature | 3 | 3¾ |
| 12 | 36 | 3 | 9 |
| 22* | 35 | 3 | 9 |
| | | 5 | 13 |
| 62 | 35 | 3 | 4 |
| 91 | 36 | 3 | 9¼ |

* Twins.

TABLE 5

PREMATURITY AT TIME OF DISCHARGE

| Case Number | Gestation Weeks | Body Weight Lb. | Body Weight Oz. | Days in Hospital | Prematurity When Discharged (weeks) |
|---|---|---|---|---|---|
| 32 | 28 | 2 | 13 | 58 | 3+ |
| 23 | 28 | 4 | 4 | 32 | 9+ |
| 48 | 29 | 2 | 8 | 53 | 3+ |
| 94 | 30 | 3 | 5½ | 33 | 5 − |
| 38 | 31 | 3 | 2 | 39 | 3+ |
| 44 | 31 | 2 | 8 | 58 | 2 − |
| 96 | 31 | 3 | 12½ | 34 | 4+ |
| 97 | 32 | 1 | 0 | 30 | 4 − |

born on the same day. From here on we find sporadic cases of births one or two months apart. Something may have occurred in the postnatal management of these infants that may have predisposed them to the development of retrolental fibroplasia.

The early fundus findings in the group of infants who developed retrolental fibroplasia are shown in Table 8. It may be seen that, in this group, fundus changes were observed at the earliest examination. The gestation time ranged from 27 to 31 weeks. None was over 31 weeks.

Table 9 shows the fundus findings of the group of infants who did not develop retrolental fibroplasia. They were of approximately the same gestation period and birth weight as the retrolental group, but their fundi were either normal or at most showed Stage II only.

The blood was examined at about two-week intervals for red-cell count and hemoglobin determination. Table 10 shows the red-cell count and hemoglobin percentage of the group of infants who were of less than 35 weeks' gestation.

TABLE 7

MONTH OF BIRTH OF GROUP WHO DEVELOPED RETROLENTAL FIBROPLASIA

| Case Number | Date of Birth |
|---|---|
| 49 | 3/29 |
| 51 | 3/22 |
| 52 | 3/22 |
| 53 | 3/29 |
| 58 | 4/24 |
| 68 | 5/24 |
| 75 | 6/18 |
| 92 | 10/25 |
| 102 | 11/30 |

Table 11 shows the blood findings in the group of infants who developed retrolental fibroplasia. A low red-cell count and low hemoglobin percentage are found in most of these prematures. Anemia is an important factor, an indication of the subnormal development of the blood-forming organs.

Table 12 shows the blood findings of the infants who were less than five weeks pre-

TABLE 6

RETROLENTAL FIBROPLASIA GROUP

| Case Number | Gestation Weeks | Body Weight Lb. | Body Weight Oz. | Days in Hospital | Prematurity When Discharged (weeks) |
|---|---|---|---|---|---|
| 49 | 27 | 2 | 7 | 66 | 5 |
| 51 | 30 | 3 | 4½ | 40 | 4+ |
| 53 | 30 | 2 | 10½ | 44 | 2+ |
| 68 | 27 | 2 | 1½ | 78 | 2 |
| 75 | 30 | 3 | 9 | 40 | 4 |
| 92 | 28 | 2 | 12 | 45 | 5+ |
| 58 | 31 | 3 | 7 | 38 | 1+ |
| 52 | 27 | 3 | 0 | 44 | 6+ |
| 102 | 27 | 2 | 12 | 78 | 2 |

TABLE 8

EARLY FUNDUS FINDINGS IN GROUP WHO DEVELOPED RETROLENTAL FIBROPLASIA

| Case Number | Gestation Weeks | Birth Weight Lb. | Birth Weight Oz. | Fundus Findings |
|---|---|---|---|---|
| 49 | 27 | 2 | 2 | Early tortuosity and dilatation of vessels. At 41 days, edema of retina with hemorrhages in periphery. At 52 days, same plus neovascularization. Type III |
| 51 | 30 | 3 | 4¼ | At 24 days, dilatation of retinal vessels. At 38 days, Type I and II |
| 52 | 27 | 3 | 0 | At 38 days, Type III |
| 53 | 30 | 2 | 10¼ | Type II |
| 58 | 31 | 3 | 7 | At 26 days, Type I and II |
| 68 | 27 | 2 | 1½ | Type II |
| 75 | 30 | 3 | 9 | At 27 days Type I<br>At 41 days Type II |
| 92 | 28 | 2 | 12 | At 11 days, Type II, later Type III. (This infant was in 40 percent oxygen from birth) |
| 102 | 27 | 2 | 2 | Type II |

mature and the "immature" group. They show red blood and hemoglobin within normal range at birth and they maintain that condition as they grow older, while those in the premature group show a decrease in their primary red-cell and hemoglobin counts.

## DISCUSSION

The development of retrolental fibroplasia appears to be a vascular reaction to some sort of stimulus, with prematurity as the primary factor. The underdevelopment of all organs that are needed for growth and development is self-evident, as manifested by the weak, shallow, and abnormal respirations, the marked anemia, the instability of body temperature, and so forth.

Mossberger[8] stated that Thormer and Lewy, who studied the histopathologic effects of repeated anoxia on the brains of cats and guinea pigs, observed that tissues of ectodermal and mesodermal origin are affected alike by perivascular hemorrhage and coagulation, irreversible reactions which destroy minute particles of brain tissue (structural and permanent lesions of nerve cells and neuroglia). The effects of repeated hypoxia were cumulative.

Nerve cells, intimately related to through capillaries, and at times even pierced by them, are extremely sensitive to sudden variations in blood oxygen. This would suggest that efficient nerve cell metabolism practically requires neural inundation by oxygenated blood.

According to J. Van Liere[9] the term anoxia may be interpreted as oxygen want, and includes all conditions of oxygen want in the body regardless of cause. Some authors use the term hypoxemia, meaning subnormal supply of oxygen.

Anoxic anoxia affects the whole body and

TABLE 9

FUNDUS FINDINGS IN GROUP WHO DID NOT DEVELOP RETROLENTAL FIBROPLASIA

| Case Number | Gestation Weeks | Birth Weight Lb. | Birth Weight Oz. | Fundus Findings |
|---|---|---|---|---|
| 7 | 28 | 3 | 13 | Normal |
| 28 | 32 | 3 | 5 | Normal |
| 32 | 29 | 3 | 13 | Normal |
| 38 | 31 | 3 | 2 | Type II |
| 40 | 28 | 3 | 11 | Temporal aspect of left disc pale; otherwise normal |
| 46 | 31 | 2 | 8 | Type II; did not progress to further stage |
| 50 | 29 | 2 | 8 | Type I |
| 54 | 30 | 2 | 7 | Attentuation of vessels; periphery gray |

TABLE 10

RED-CELL COUNT AND HEMOGLOBIN DETERMINATION OF PREMATURES OF 35 WEEKS' OR LESS GESTATION WHO DID NOT DEVELOP RETROLENTAL FIBROPLASIA

| Case Number | Gestation Weeks | Birth Weight Lb. | Birth Weight Oz. | Red Cell Count | Percent Hemoglobin |
|---|---|---|---|---|---|
| 44 | 31 | 2 | 8 | 2,990 | 46.1 |
| | | | | 2,630 | 49.8 |
| 46 | 31 | 4 | 10 | 3,880 | 76.0 |
| 48 | 29 | 2 | 8 | 4,210 | 87.8 |
| 54 | 30 | 2 | 7 | 3,180 | 74.3 |
| | | | | 2,670 | 58.3 |
| | | | | 1,770 | 35.0 |
| | | | | 1,750 | 36.0 |
| | | | | 2,350 | 39.0 |
| 74 | 33 | 2 | 14¼ | 3,270 | 80.1 |
| | | | | 3,250 | 51.0 |
| 77 | 34 | 3 | 11½ | 4,390 | 105.8 |
| | | | | 3,810 | 74.3 |
| 78 | 31 | 4 | 2¼ | 3,580 | 78.8 |
| 79 | 35 | 4 | 1 | 3,850 | 87.8 |
| 80 | 32 | 3 | 4 | 5,050 | 99.4 |
| | | | | 3,390 | 67.9 |
| 81 | 31 | 3 | 1 | 3,450 | 73.0 |
| | | | | 3,330 | 58.0 |
| 84 | 27 | 2 | 7 | 3,600 | 77.6 at 22 days |
| | | | | 3,000 | 62.7 |
| | | | | 3,010 | 62.2 |
| 86 | 32 | 3 | 14¾ | 4,800 | 97.3 |
| 87 | 34 | 6 | 0 | 4,350 | 87.0 at 21 days |
| 90 | 30 | 2 | 7 | 2,960 | 62.0 at 35 days |
| | | | | 2,330 | 46.7 |
| | | | | 2,550 | 51.5 |
| 94 | 30 | 3 | 5¼ | 3,150 | 70.0 |
| 95 | 33 | 3 | 11¼ | 3,670 | 80.0 |
| 97 | 32 | 4 | 0 | 4,580 | 102.4 at 22 days |

may be produced by the following conditions:

1. Anemia
2. Low-tension oxygen in the inspired air, as in high altitudes
3. Abnormal conditions within the lungs
4. Shallow respiratory movements from any cause

Duke-Elder[6] states that the formation of new vessels in the retina is not uncommon, occurring in many cases in which the circulation has been impaired or obstructed. In all cases the process is a purposeful one and represents an attempt to supply a system of collaterals which can take over the supply of an area, the nourishment of which has been impaired.

Van Liere further states that at normal atmospheric pressure of 760 mm. Hg, oxygen exerts a partial pressure of 159 mm. Hg. At this partial pressure of oxygen, the hemoglobin in the arterial blood is 95 percent saturated with oxygen, or contains 19 volumes percent. (Full saturation would be

TABLE 11

RED-CELL COUNT AND HEMOGLOBIN DETERMINATION OF PREMATURES WHO DEVELOPED RETROLENTAL FIBROPLASIA

| Case Number | Red-Cell Count | Hemoglobin (percent) | Age of Infant (days) |
|---|---|---|---|
| 49 | 2,430 | 49.9 | 48 |
| | 2,540 | 42.3 | 65 |
| 51 | 5,010 | 103.8 | 3 |
| | 6,160 | 123.7 | 14 |
| 53 | 4,250 | 96.7 | 9 |
| | 3,250 | 63.5 | 23 |
| | 2,440 | 48.0 | 30 |
| 58 | 4,240 | 86.5 | 14 |
| 52 | 5,010 | 130.8 | 2 |
| 68 | 2,160 | 44.0 | 27 |
| | 2,180 | 37.1 | 36 |
| | 3,020 | 59.6 | 57 |
| | 3,330 | 56.8 | 65 |
| 75 | 4,150 | 92.9 | 13 |
| | 3,850 | 71.2 | 27 |
| 92 | 3,170 | 69.0 | 28 |
| | 2,330 | 46.7 | 36 |
| 102 | 4,380 | 92.6 | 12 |
| | 2,370 | 44.7 | 31 |
| | 2,490 | 51.0 | 52 |

equal to 20 volumes percent.) As the blood passes through the capillary bed, approximately five volumes percent of oxygen are removed, so that the mixed venous blood contains 14 volumes percent or a hemoglobin saturation of 70 percent. The oxygen, therefore, is carried to the tissues at a relatively high pressure, so that there is a high-pressure gradient between the blood capillaries and the tissues.

During anoxic anoxia the partial pressure of oxygen and saturation of hemoglobin are both reduced, depending of course upon the severity of the anoxia. Thus the high-pressure gradient between the blood in the capillaries and the tissues is reduced, so that it becomes much less effective in supplying oxygen to the tissues.

It is now recognized that the reduction in the partial pressure of oxygen in the arterial blood is more important than the lack of oxygen saturation. Evidence is also available t[illegible] the velocity of oxidative processes in the tissues is proportional to the partial pressure which the oxygen exerts. The lowering, then, of the partial pressure of oxygen in inspired air is indeed a serious handicap to the body.

TABLE 12

RED-CELL COUNT AND HEMOGLOBIN DETERMINATION OF "IMMATURE" INFANTS AND THOSE LESS THAN FIVE WEEKS PREMATURE

| Case Number | Gestation Weeks | Red-cell Count | Hemoglobin (percent) |
|---|---|---|---|
| 50 | 40 | 5,420 | 141.0 |
| | | 4,910 | |
| 56 | Immat. | 5,350 | 117.3 |
| | | 4,300 | 85.3 |
| 67 | 38 | 4,480 | 95.5 |
| | | 4,810 | 100.0 |
| | | 4,200 | 92.9 |
| 70 | Immat. | 4,550 | 88.4 |
| 72 | Immat. | 4,290 | 100.0 |
| 73 | 35 | 5,250 | 88.4 |
| 76 | Immat. | 4,610 | 96.7 |
| | | 4,300 | 84.0 |
| | | 4,480 | 105.0 |
| 83 | Immat. | 4,990 | 103.0 |
| 89 | Immat. | 4,360 | 102.4 at 17 days |
| 92 | 37 | 4,920 | 97.3 |
| 93 | 36 | 3,860 | 77.6 at 27 days |
| 99 | Immat. | 4,170 | 81.0 |
| 100 | 39 | 6,040 | 129.2 |
| 103 | 36 | 5,500 | 107.0 |
| 105 | 35 | 5,070 | 113.0 |

Finally, the increased respirations produced by anoxia wash the carbon dioxide out of the lungs, and as a consequence the carbon-dioxide arterial pressure falls. It is known that one of the important factors in the dissociation of oxygen from oxyhemoglobin is the carbon-dioxide tension in the arterial blood. Since, during anoxia, the carbon-dioxide tension is decreased, the hemoglobin does not give up its oxygen readily and, in consequence, the tissues suffer from oxygen want although there may be adequate oxygen in the blood.

Wright[10] states that the tissues in this type of anoxia are hampered in three ways: (1) The rate of oxidation is diminished because of low tension in the blood; (2) there is less oxygen in the blood than normally; and (3) the low carbon-dioxide tension hampers the dissociation of oxyhemoglobin.

According to Arthur H. Keeney,[8] the chronologic development of an infant during the seventh month shows that the rods and cones can be distinguished morphologically in many specimens. The ora serrata is at the level of the middle ciliary body. The nerve-fiber layer is not yet formed in the most peripheral retina. The ganglionic cell layer thins to only three or four cells thickness at the macula. The retinal vessels grow into the ganglionic layer.

During the eighth lunar month, nuclei of rods and cones differentiate; the ora serrata is at the posterior one third of the ciliary body; the ganglionic cells are only two deep at the fovea now, four deep in the pericentral area; the bipolar cells thin out slightly.

In a premature infant, born during the 27th or 28th week of gestation, the retina is, as yet, not fully formed. Especially at the periphery are the inner layers of the retina, the ganglionic and nerve-fiber layers still in the formative stage. The vessels are beginning to grow into the ganglionic layer.

The pathogenesis of retrolental fibroplasia is as described by Reese and Blodi,[11] the histologic changes consisting of nests of epithelial cells and glial proliferation in the equatorial area of the nerve-fiber layer of the retina. Thus we find a common area of development and pathology.

Something occurs at this time of the infant's development that either interferes with or stimulates the normal processes of development, the growth of vessels into the ganglionic layer and nerve-fiber layers. It seems possible that whatever the stimulus or interfering agent may be, the normal growth of these vessels may be intensified with the beginning of the disease of retrolental fibroplasia.

In my series I have found the *critical period* to be between the 27th and 31st week of gestation, the period during which the above processes occur. Further investigation will be necessary to solve the important problem of what occurs during this critical period of the infant's development.

What is the agent that causes the overgrowth of the normally growing vessels in the ganglionic and possibly in the nerve-fiber layer in the periphery of the retina?

Crosse and Evans[7] of England are of the opinion that the real source of this disease lies in the prolonged use of a high concentration of oxygen in the early life of premature infants of low birth weight, four pounds or less, since the occurrence of this disease is restricted entirely to centers with special units for premature babies.

Is it possible that, in spite of the fact that the infant is in an 85-percent oxygen atmosphere, it is still not able to utilize its needed requirement of oxygen because of its anemia and all other factors of subnormal development?

Or is it an unknown agent which the mother supplies during the intrauterine life of the infant?

Case 92, one of the nine infants who developed retrolental fibroplasia, was in 40-percent oxygen from birth. In my new series, the minimal amount of oxygen consistent with the infant's safety is being supplied.

## Conclusions

1. The prematurity of the infant, not the birth weight alone, is the important factor.

2. The critical period is the time at which the normal development of the inner layers of the retina at the periphery takes place; that is, the 27th to 32nd week of gestation.

3. Something either stimulates or interferes with this normal process, the growth of retinal vessels into the ganglionic and nerve-fiber layers at the periphery of the retina. The intensification of the growth of these vessels may be the beginning of the condition which results in retrolental fibroplasia.

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## References

1. King, M. J.: Retrolental fibroplasia. Arch. Ophth., **43**:694-711 (Apr.) 1950.
2. Kinsey, V. E., and Zacharias, L.: Retrolental fibroplasia, J.A.M.A., **139**:572-578 (Feb.) 1949.
3. Owens, W. C.: Retrolental fibroplasia. Am. J. Pub. Health, **40**:405-408 (Apr.) 1950.
4. Unsworth, A. C.: Retrolental fibroplasia. Tr. Am. Ophth. Soc., **47**:738-771 (June) 1949.
5. Mossberger, J. I.: Am. J. Dis. Children, **78**:28, 1949.
6. Duke-Elder, W. S.: Textbook of Ophthalmology. St. Louis, Mosby, v. 3, p. 2618.
7. Crosse, V. M., and Evans, P. J.: Arch. Ophth., **48**:83 (July) 1952.
8. Keeney, A. H.: Chronology of Ophthalmic Development. Springfield, Ill., Thomas, 1951.
9. Van Liere, E. J.: Anoxia: Its Effect on the Body. Chicago, Univ. Chicago Press, 1942, p. 4.
10. Wright, S.: Applied Physiology. London, Oxford Univ. Press, 1937, ed. 6, p. 476.
11. Reese, A. B., Blodi, F. C., and Locke, John C.: Am. J. Ophth. **35**:1407 (Oct.) 1952.

## Discussion

Dr. Kenneth L. Roper (Chicago): Since Terry[1] first drew attention, in 1942, to the disease entity known as retrolental fibroplasia, cases have been reported with ever increasing frequency both in this country and abroad. Dr. Franklin M. Foote,[2] Executive Director of the National Society for the Prevention of Blindness, New York, has stated that 49 percent of the blindness in children under seven years of age is due to retrolental fibroplasia.

Certain definite facts have been established and agreed upon by clinicians—that it is a disease of prematurity, occurring predominantly in infants whose birth weight is three pounds or less and of gestational age of six to seven months. On this point Dr. Apple, from his observations, has stressed that it is not so much the *birth weight* but the *prematurity* of the infant that is the important factor. He further stresses that the critical period is between the 27th and 32nd week of gestation; and that something either stimulates or interferes with the normal retinal developmental processes during this period.

It has been further definitely established that this is primarily a disease of the retina and vitreous, observed generally four to six weeks after birth. Dilatation of the retinal vessels is noted first, followed by retinal and vitreous hemorrhages, exudate, retinal separation, neovascularization, and a cyclitic membrane leading to fibrous organization of fused retina behind the lens.

So much and no more do we know—here we become speculative. But recent clinical and investigative reports have stimulated our hopes. Up to the present time the great bulk of important work on this subject has been carried out on its clinical and pathologic aspects. Little progress has been made in determining its etiology. It is clear that the primary pathologic change is angioblastic in

nature, leading to proliferation of the endothelial cells and vessels into the vitreous, and finally detachment.

Nearly two years ago some important clinical reports were made on the possible role of oxygen therapy in retrolental fibroplasia.

Patz and his co-workers[3] carried out a three-year controlled oxygen administration program in the premature nursery of the Gallinger Municipal Hospital, Washington, D.C. They found that a correlation existed between prolonged oxygen therapy and retrolental fibroplasia. Seven of 28 infants in prolonged high oxygen environment progressed to Grades 3 and 4 retrolental fibroplasia; of 37 infants kept in lower oxygen environment none progressed beyond Grade 2 changes.

Szewczyk[4] presented pertinent evidence in support of the thesis that anoxia plays a major role in the production of this mysterious disease.

At the same time Ingalls and his group[5] came up with experimental evidence that anoxia in the pregnant mouse is capable of producing a number of congenital malformations of the eye.

Again, at this same time, we had the report by Ryan[6] of Australia advancing the idea that retrolental fibroplasia is due to the toxic effect of oxygen—that it stimulates mitoses and overgrowth of connective tissue, increased vascularity, and so forth. Ryan's evidence, while not as convincing as the others, did serve to cast doubt on other theories. I am sure we realize more and more that oxygen is not as benign an agent as it was once thought to be.

The controversy centering in the role of oxygen in the etiology of retrolental fibroplasia has led to some very important investigative studies.

Patz and his co-workers[7] investigated the ocular effect of oxygen on several species of animals—mice, rats, dogs, and kittens—and noted that the effect of oxygen is not an individual species susceptibility. Another point these workers brought out, which is most fascinating, is that oxygen produced changes only in the eyes of the animals; and lastly, the lesions that were produced were directly proportional to the concentration of oxygen used.

Ashton and his co-workers[8, 9] studied the immediate and remote effects of high and low concentrations of oxygen upon the retinal vascularization during the first three weeks of the kitten's life. The phenomena they observed were regarded as significant in the genesis of retrolental fibroplasia in the human.

Dr. Algernon B. Reese[10] and Dr. Jonas S. Friedenwald,[11] who examined the histologic preparations of these two investigators, agreed that they had produced striking facsimiles of the disease in their experimental animals; and that such experimental evidence makes it almost certain that oxygen is an important factor in the precipitation of retrolental fibroplasia in human beings.

There is little question that the experimental findings of these two groups of workers are sufficiently definite to indicate that the uncontrolled employment of oxygen is extremely dangerous in the treatment of premature babies in that it is able to destroy the normal processes of retinal vascularization.

These results should have the immediate effect of persuading clinicians to measure accurately the oxygen concentrations to which these infants are subjected and to give only the minimal amount for the shortest possible period consistent with the infant's survival.

## References

1. Terry, T. L.: Extreme prematurity and fibroplastic overgrowth of persistent vascular sheath behind each crystalline lens: Preliminary report. Am. J. Ophth., **25**:203 (Feb.) 1942; Ocular maldevelopment in extremely premature infants: Retrolental fibroplasia: General consideration. J.A.M.A., **128**:582 (June) 1945.

2. Foote, F. M.: Personal communication, October, 1953.
3. Patz, A., Hoeck, L. E., and de la Cruz, E.: Studies on the effect of high oxygen administration in retrolental fibroplasia: I. Nursery observations. Am. J. Ophth., **35**:1248-1253 (Sept.) 1952.
4. Szewczyk, T. S.: Retrolental fibroplasia: Etiology and prophylaxis. Am. J. Ophth., **35**:301-311 (Mar.) 1952.
5. Ingalls, T. H., Tedeschi, C. G., and Helpern, M. M.: Congenital malformations of the eye induced in mice by maternal anoxia: With particular reference to the problem of retrolental fibroplasia in man. Am. J. Ophth., **35**:311-329 (Mar.) 1952.
6. Ryan, H.: Retrolental fibroplasia: A clinicopathologic study. Am. J. Ophth., **35**:329-342 (Mar.) 1952.
7. Patz, A.: Animal experiments in retrolental fibroplasia. Presented before the Am. Acad. Ophth., Chicago, October 13, 1953.
8. Ashton, N., Ward, B., and Serpell, G.: Role of oxygen in the genesis of retrolental fibroplasia: A preliminary report. Brit. J. Ophth., **37**:513-520 (Sept.) 1953.
9. Ashton, N.: Animal experiments in retrolental fibroplasia. Presented before the Am. Acad. Ophth., Chicago, October 13, 1953.
10. Reese, A. B.: Discussion of Patz[7] and Ashton.[8]
11. Friedenwald, J. S.: Discussion of Patz[7] and Ashton.[8]

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# RETINOPATHY OF PREMATURITY (RETROLENTAL FIBROPLASIA) AND OXYGEN*

## Part I. Clinical study
## Part II. Further observations on the disease

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### Part I. Clinical study

In a previous paper from the Philadelphia General Hospital[1] certain conclusions were drawn from an analysis of 44 cases of retinopathy of prematurity in 127 infants below the birth weight of 4.5 pounds. It was concluded that high oxygen concentrations and the prolonged use of oxygen supplements predisposed to the disease. However, it was also concluded that the most common precipitating factor was the too rapid withdrawal of these oxygen supplements. Further testing of these conclusions is now being carried out by controlling the oxygen environments of all premature infants under four pounds. The incidence of the disease and its severity can then be determined under various oxygen environments with and without weaning from oxygen. Part I of this paper is based on the first of this series of studies using controlled oxygen environments.

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### Methods and Materials

All premature infants of four pounds or less birth weight were alternately placed in a group to be weaned from oxygen (Group A) and a group to be suddenly withdrawn from oxygen (Group B). This was done after first separating the infants according to weight. Infants between three and four pounds received oxygen for 11 days. Those three pounds or less received oxygen for 17 days according to the schedules outlined in Table 1.

Thus Group B infants had slightly higher oxygen supplements which were withdrawn suddenly, while Group A infants were in slightly lower oxygen concentrations and were gradually weaned. The infants were grouped by the pediatric department. The ophthalmologists were not aware of the group to which an infant they were examining belonged. Concentrations were repeatedly checked with a Beckman oxygen analyzer and were accurate within $\pm 5.0$ percent of the desired concentration.

TABLE 1

OXYGEN SCHEDULE

| | | | |
|---|---|---|---|
| Group A (weaned from oxygen) | | | |
| I. (3–4 lb.) | | II (3 lb. or less) | |
| 50% oxygen | 1 day | 50% oxygen | 7 days |
| 40% oxygen | 5 days | 40% oxygen | 5 days |
| 30% oxygen | 5 days | 30% oxygen | 5 days |
| | 11 days | | 17 days |
| Group B (not weaned from oxygen) | | | |
| I. (3 to 4 lb. or less) | | II. (3 lb. or less) | |
| 60% oxygen | 11 days | 60% oxygen | 17 days |

The infants were examined at weekly intervals until they were out of oxygen for one month and if normal, every two weeks until they were discharged. Those with abnormal fundi were seen at weekly intervals. Patients were referred to the eye clinic for follow-up after discharge.

All infants with a birth weight between 4.0 and 4.5 pounds were given oxygen for only a few days at the discretion of the pediatrician, and were examined every two weeks. This group of infants was examined because we had previously observed the disease in a number of infants who weighed more than four pounds at birth.

Mydriasis was obtained with 0.25-percent atropine and 5.0-percent neosynephrine. A small self-retaining speculum was used to facilitate the examination.[2] Such an instrument saves time and, in most instances, is essential for an adequate examination of the fundus of premature infants.

If an infant was thought to be developing the disease, a second ophthalmologist was called in to confirm the findings. If the disease appeared to be progressive, the ophthalmologist was told of the infant's group and the infant was placed back in oxygen at the same concentration from which he had been removed. Because our results with oxygen therapy had been uniformly successful, we did not feel it was fair to withhold treatment in order to obtain control cases.

## CLASSIFICATION

For the purposes of this study, the disease was classified into the following stages:

Stage I. Dilated and tortuous blood vessels

Stage II. Hemorrhages, edema, and/or neovascularization

Stage III. Retinal detachment

Stage IV. Retrolental membrane

TABLE 2

INCIDENCE OF RETINOPATHY

| Group | | No Disease | Disease | | | | |
|---|---|---|---|---|---|---|---|
| | | | | Stage 1 | 2 | 3 | 4 |
| A (Weaned from 50% oxygen) | I | 19 | | 1 | | | |
| | II | 3 | | | | 1* | |
| Total Group A | | 22 | 2 | | | | |
| B (Not Weaned from 60% $O_2$) | I | 12 | | 1 | 2 | 2 | |
| | II | 0 | | 2† | 3 | 3 | |
| Total Group B | | 12 | 13 | | | | |

* Small peripheral detachment in one eye of a hydrocephalic infant. Only mild Stage 1 disease developed in other eye.

† Disease appeared in one of these infants four weeks after she was removed from oxygen in association with severe upper respiratory infection.

## Results

Table 2 shows the incidence of the disease in infants who received oxygen according to the plan. As can be seen, only two of 24 infants in Group A developed the disease, while 13 of the 25 infants in Group B developed the disease. Furthermore, the retinopathy was more severe in Group B (the nonweaned group given a slightly higher concentration of oxygen).

For statistical purposes, Groups A-I and A-II have been analyzed together, since they were weaned from an oxygen environment of 50 percent in a similar way; and Groups B-I and B-II were analyzed together since they were not weaned from 60-percent oxygen.

Using the $X^2$ method as shown in Table 3, the results are highly significant that the incidence was greater in Group B than in Group A.* One must therefore conclude that higher oxygen concentrations without weaning increases the incidence of retinopathy of prematurity. That the disease is the result of a relative anoxia rather than oxygen toxicity is suggested by further data.

The first evidences of the disease appeared in 13 of the 15 cases on the first examination after the infants were removed from oxygen (within seven days). Because of the marked vitreous haze, it was difficult to tell exactly when the disease was present in one infant. The other infant developed the first evidences four weeks after she had been removed from oxygen. The onset was in association with a respiratory infection. This is consistent with the findings in the previous paper,[1] that the great majority of infants developed the first evidence of the disease just after oxygen supplements were withdrawn.

Two infants did not receive oxygen according to the plan and are not included in the statistical analysis. Both of these infants deserve special mention because they also developed retinopathy. These infants had their oxygen supplements stopped according to schedule (IB and IIA), but were given more oxygen because they developed pneumonia.

The acute phases of retinopathy appeared when the infants were taken out of oxygen the second time. This would suggest that respiratory infections may increase the sensitivity of the infant to oxygen fluctuations or precipitate the disease.

Another infant with a birth weight over four pounds also developed the disease. This child received oxygen intermittently beneath a plastic hood for about 10 days and developed the acute phases of the disease in both eyes just after the oxygen was stopped. The condition subsided in one eye while the other eye developed a very loose but almost complete retinal detachment. This detachment, however, did not progress but completely receded within three weeks. The retina has only a "moth-eaten" appearance as a residue of this detachment.

Seven infants with the disease were given oxygen therapy because the disease appeared to be progressive. In all of these cases, improvement in the fundi of both eyes occurred after therapy was instituted the first time. A recurrence of the disease took place in three of these infants when oxygen therapy was stopped. One infant was given oxygen therapy with successful results three times because of recurrences on each withdrawal.

The successful results of oxygen therapy confirm the reports of Szewczyk[2] and Bedrossian,[1] that oxygen is effective in the early stages of the disease.

The recurrences of the disease on withdrawing the oxygen which was given thera-

* Statistical analysis supervised by Mr. Hyman Menduke, associate in medical statistics, Woman's Medical College of Pennsylvania.

TABLE 3

Statistical analysis

| | No Disease | Disease |
|---|---|---|
| Group A | 22 | 2 |
| Group B | 12 | 13 |

$\chi^2 = 10.81$ $p\chi^2 = 0.001$ (highly significant)

peutically and the occurrence of the disease in association with respiratory infections further suggest that the disease is primarily anoxic in character.

### Summary of Part I

1. Thirteen of 25 infants suddenly removed from oxygen after being in an environment of 60-percent concentration for from 11 to 17 days, developed retinopathy of prematurity. Only two out of 24 infants who were in oxygen from 11 to 17 days and were weaned over 10 days from 50-percent concentration, developed the disease. This difference is highly significant statistically. The disease was much more severe in the former group.

2. Two infants with pneumonia received extra oxygen and developed the disease on withdrawal of the extra oxygen supplements. One infant who received oxygen intermittently for 10 days also developed the disease.

3. Oxygen therapy was successful in seven of the most progressive cases. Recurrence of the disease took place in three of these infants when therapy was stopped.

4. The first evidences of the disease in 16 of the 18 infants appeared within seven days of their removal from oxygen.

### Conclusions for Part I

1. High oxygen concentrations and the prolonged use of oxygen predispose to the development of retinopathy of prematurity. Therefore oxygen supplements given to premature infants should be limited to those necessary for the infants' well being.

2. The most common precipitating factor in the disease is withdrawing these oxygen supplements too rapidly. Weaning from oxygen should be by gradual reduction of the oxygen concentration of the infant's environment by no more than 10 percent every five days.

3. Respiratory infections and other general diseases may predispose to and precipitate the disease.

4. Every premature infant under 4.5 pounds birth weight should have regular fundus examinations.

## Part II. Further observations on the disease

The large volume of literature on retinopathy of prematurity in the past four years has added much to the knowledge of the disease. Because the disease is so variable, many apparently conflicting observations have been made. This has created some confusion in practically every phase of the disease.

It is the purpose of Part II of this paper to show that some of these apparently conflicting observations are not really contradictory but are only variants of similar processes. Some phenomena not generally mentioned are also included. These thoughts and observations are based on the experience of one of us (R. H. B.) in making over 2,000 examinations on over 250 premature infants and observation of 74 infants during the entire course of the disease, as well as four others after the disease was well developed.

### Method of examination

After a trial with practically all the suggested mydriatics, five-percent neosynephrine and 0.25-percent atropine were found to be the most dependable. One drop of this mixture will dilate the pupil within 20 minutes. The dilatation will last about four hours. The instillation of the drops usually requires one person to hold the lids open and another one to put the drops in. Occasionally a blonde infant will get a slight flush from the drops but this is rare except when an overzealous mother instills more than one drop at the inner angle.

A small speculum[8] is needed in examining the smaller infants (below 5.5 pounds). Such an instrument saves time and permits examination of the extreme periphery of the fundus. This is important since the only changes of the disease may be present in the periphery, and it is in the periphery that the first evidence of the disease appears. Over 50 percent of examinations are unsatisfac-

tory when the fingers are used to hold the lids open. Many palpebral fissures are too small to hold open with the fingers, and the lids often evert when this method is used.

A bottle given to a larger hungry infant with a good sucking reflex will often occupy the infant sufficiently to permit a good examination. This usually works fairly well from the time the infant is discharged from the hospital up to the age of about six months.

## Classification of Stages and Clinical Course

The great variability of the course of the disease has resulted in many different classifications for the stages of the disease. Dividing the disease into an acute and cicatricial phase and then subdividing each of these phases into various stages has some merit, but is not practical for clinical purposes. Generally, the most practical and accurate classification seems to be the following:

Stage I. Dilated and tortuous vessels

Stage II. Stage I and hemorrhages, edema, and/or neovascularization

Stage III. Retinal detachments, retinal holes

Stage IV. Retrolental membrane.

Vitreous haze may be present in any stage and on occasion may be severe enough to prevent good visualization of the fundus.

It appears that Stage II is not really a continuation of Stage I but a separate process caused by the same etiologic agent. In a number of infants the retinal vessels returned almost to normal before the appearance of visible hemorrhages, neovascularization, or retinal detachments. Furthermore, the degree of dilatation and tortuosity is not always a criterion of the ultimate outcome.

A few cases have been seen in which there was a question as to whether the vessels were dilated and tortuous or in which only the small vessels in the extreme periphery were abnormal; still hemorrhages, retinal holes, and small detachments appeared later. The degree of dilatation and tortuosity does, however, closely correlate with the acuteness of the disease and the rapidity of its progress.

The temporal retina was involved first about five times more frequently than the nasal retina. This may be due to the longer length of the temporal vessels when compared to the nasal vessels during their embryologic growth period.[4]

Hemorrhages, as seen in Stage II, may be either central or peripheral, and may appear before neovascularization is visible. Neovascularization, on the other hand, is almost always peripheral. Therefore, hemorrhages probably are not only the results of leaks from abnormal new vessels but also from pre-existing vessels. Neovascularization occasionally appears centrally at the site of old hemorrhages. Patchy areas of retinal atrophy also may appear at the site of old hemorrhages.

As was mentioned before, retinal detachments may appear even when the acute vascular phases of the disease seem to be subsiding. Detachments have always been considered a poor prognostic sign and are generally thought to be irreversible.

In 74 infants with the acute phases of the disease, 49 eyes had detachments of all degrees. The detachments in 20 of these eyes receded completely. Some of these 20 eyes had thin fibrous bands or distorted fundi as sequelae but no mass or elevated retina was visible. Some detachments developed into retinal folds, some of which became permanent while a few others disappeared.

Not all of the retinal detachments were of the solid type. Seven eyes had almost complete detachments that looked similar to the usual serous detachments. Most of these became fibrotic later. One retinal detachment, which was almost complete, receded entirely within three weeks of the time of its maximum separation, leaving only a moth-eaten appearance to the retina.

Clinically, therefore, one may suspect that not all the detachments are due to vitreous contractures or a positive taxis from the vitreous.

Retinal holes, disinsertions, and patchy

areas of retinal atrophy were seen in nine eyes. These were at the site of old hemorrhages, detachments, or appeared where no previous pathologic process was noted.

Fifteen eyes showed well-demarcated areas in the peripheral retina that were not elevated and beyond which the choroidal circulation was visible. The retinal vessels came up to this point and looped back or paralleled the demarcation. This is probably the point to which the intrinsic retinal blood vessels have developed in their growth anteriorly.[4, 5] Eight of these 15 eyes eventually developed retinal detachments or folds in this area, while the other seven showed no residue.

Retinal folds were present in eight eyes during the acute phases of the disease. The fold was a regression of a retinal detachment in two of these eyes, while in one the fold became a detachment. In the other five, the fold receded. Retinal vessels may be visible peripheral to the fold. These folds can be confused with retinal disinsertions which were seen in three eyes. Here the retina comes forward into the vitreous and bare choroid is visible behind.

Four eyes with retinal detachments and one eye with a retinal disinsertion were subjected to subretinal taps. All five cases had an amount of subretinal fluid comparable to the degree of separation.

Although a retrolental membrane may appear rapidly, it more often comes on slowly. Therefore it is important to be careful in giving a prognosis to parents. Parents frequently will state that their child seemed to see for about two months prior to the time they noticed the "white cast." Almost complete detachments have been seen for as long as four months during which time the pupils reacted well to light and the anterior chambers remained deep. Finally the anterior chambers became very shallow, posterior synechias formed. The pupils did not respond to light, and the retina became completely disorganized.

### Oxygen and its relationship

Patz,[6] Ryan,[7] and Crosse and Evans[8] have all shown that the incidence of retinopathy significantly decreases when the oxygen supplements routinely given to many premature infants are reduced to a minimum.

Szewczyk[9] has reported that oxygen therapy is beneficial in treating the early stages of the disease. Furthermore, most infants get the disease after they are removed from oxygen. (Only six* of our 74 infants with the disease developed it while receiving oxygen. All but one of the remaining 68 developed the disease within two weeks after being removed from oxygen.)

The only possible conclusion from these apparently incompatible observations is that the disease is due to a relative anoxia. This anoxia is due to the adaptation of the infant to high oxygen concentrations which is followed by the too rapid withdrawal of oxygen supplements.

It is known that carbon dioxide and oxygen have marked effects on cerebral and retinal vessels.[10] Oxygen and low carbon-dioxide tensions result in vasoconstriction while carbon dioxide and anoxia cause vasodilatation. LaMotte[11] observed that the onset of first stage of retinopathy of prematurity (increase in tortuosity and vascular engorgement) was often preceded by marked vascular attenuation and straightening.

One of us (R. H. B.) also observed this phenomenon in a number of infants. This occurred, however, when the infants were in oxygen. The dilatation and tortuosity appeared after the oxygen supplements were stopped.

It is probable that the infants who display this narrowing of retinal vessels while receiving oxygen have an excess of oxygen in the blood. Such infants would be more sensitive to a sudden decrease in their oxygen supply. The response to such a decrease is vasodilatation and increased tortuosity. The relative anoxia which results also could

* Two of these six infants had pneumonia; one, congenital heart disease; one, a subcapsular abscess at the time the disease developed. The other two infants were near the end of their "weaning" from oxygen when the disease was first noted.

cause damage to the pre-existing capillaries with subsequent hemorrhage, as well as result in an abnormal and disorderly proliferation of the capillary buds which are forming to complete the retinal circulation. Thus it would appear that the same factor (a relative anoxia) may produce two different processes: (1) Dilatation of the retinal vessels and (2) abnormal capillary proliferation at the ends of the growing retinal vessels.

Accumulation of waste products in the retina due to absorption of hemorrhages and edema may further add to the degree of dilatation of the retinal vessels.

Further evidence that the disease is anoxic in character is the observation of the onset of the disease with pneumonia or respiratory infections in nine infants, and exacerbations of resolving disease in three infants with similar respiratory diseases.

### Oxygen therapy

Oxygen therapy was given to 24 infants with the acute phases of the disease because the disease was rapidly progressing. In every case the response was favorable. The eyes of 18 infants returned to normal. In one infant, there were almost complete rapidly progressing retinal detachments. Upon treatment, the marked vitreous haze cleared and no further progression of the detachments occurred. In the remaining five infants, the blood vessels became normal, the retinal edema disappeared, no new hemorrhages formed but small peripheral elevations appeared or the fundi became distorted on resolution of the disease. The return of the vessels to normal occurs within two weeks, whereas, when spontaneous regressions occur, it takes from four to six weeks from the time the disease reaches its peak.

The principle of therapy is to restore the infant to the same oxygen environment from which he was removed. This will eliminate the secondary anoxia which occurs.

Recurrence of the acute phases of the disease took place in 14 of the infants when therapy was stopped. One infant was given oxygen therapy for the disease four times because the disease reappeared each time therapy was stopped. Generally, however, oxygen therapy was less effective in the recurrent cases or in the infants for whom it was delayed. Anatomic and metabolic changes probably took place which were irreversible and this made the therapy less effective.

The reported failures of oxygen therapy probably were the results of anatomic and metabolic changes which had progressed too far to be entirely reversed by elimination of the initial precipitating factor. Failures of oxygen therapy may also be expected if the precipitating factor is associated with some other condition, such as pneumonia, congenital heart or lung disease, atelectasis, or some unknown pathologic process.

It is also possible that the direct effects of high oxygen concentrations produce lesions in the eyes as shown by Patz.[14] Therefore oxygen therapy might aggravate the condition. This situation is probably rare.

### Other observations

*Transfusions.* It has been reported that blood transfusions may make the disease worse.[13] Only nine of the 74 infants with the disease received transfusions. Two received the transfusion more than two weeks before the disease developed; one received it just before; and six during the acute phases of the disease. In only one of the latter six infants did the disease become worse after the transfusion. It would seem, therefore, that transfusions seem to have little or no effect on the disease.

*Tunica vasculosa lentis.* Most of the smaller premature infants (under 4.0 to 5.0 pounds) have remnants of this structure. One might expect that its presence and state of atrophy would be a good criterion as to the state of vascular development of the eye, and consequently one might be able to tell when the infant was safe from the developing retinopathy.

Unfortunately, this did not appear to be true since no visible remnants of the tunica vasculosa lentis were present at birth in some

of the infants who developed the disease. In others, this structure had atrophied before the disease developed. One should probably be more cautious, however, in watching those infants with a marked tunica vasculosa lentis which persists for a long time. Hyaloid artery remnants are unusual and were seen in only a few of the infants.

*General diseases.* The only three premature infants with hydrocephalus developed retinopathy. One infant with congenital heart disease, one with septicemia, and two with abscesses (occipital and subscapular) also developed the disease. As mentioned before, respiratory infections were directly associated with the course of the disease in 12 infants.

Infants who do not do well from the pediatric point of view seem more susceptible to the disease. This may be partly due to the "shock" mechanism or may be associated with the fact that these are the infants who are usually given more oxygen over a prolonged period of time.

## Mechanisms involved

It is our opinion that, although retinopathy of prematurity is primarily anoxic in character, the direct effect of oxygen is an important factor in the development of the disease. Therefore, three mechanisms by which the disease may develop are suggested. These may take place either separately or in combination. Other lesser factors may also be involved.

The use of supplemental oxygen is a prerequisite for the first two mechanisms. Patz[14] and Ashton[13] have produced narrowing and obliteration of retinal vessels by placing new born animals in high oxygen atmospheres. This coincides closely with LaMotte's observation[11] that many premature infants have attenuation of the retinal vessels before they develop the disease. This narrowing would produce a decrease in the blood supply to the incompletely vascularized retina. This reduced blood supply is compensated by the increased blood oxygen level. Either of the following then takes place:

1. The sudden or improper withdrawal of oxygen supplements reduces the blood oxygen level rapidly and throws the blood supply-blood oxygen level ratio out of balance and a local anoxia develops in the retina. Exaggerated and abnormal compensatory mechanisms take place which disturb the orderly progression of the growing retinal vessels. This results in abnormal and uncontrolled capillary proliferation, hemor-

TABLE 4

Mechanisms involved in the development of the retinopathy of prematurity

| *Supplemental Oxygen* | | *No Supplemental Oxygen* |
|---|---|---|
| Narrowed blood vessels and decreased blood supply (compensated by increased blood oxygen level) | | Acute respiratory or other general disease |
| Rapid withdrawal of oxygen supplements | Infant continued in oxygen | Lowered blood oxygen |
| Sudden lowering of blood oxygen level | More narrowing of retinal blood vessels | Anoxia |
| Decreased blood supply no longer compensated | Ischemia | |
| Anoxia of tissues | Tissue anoxia despite adequate blood oxygen level | |
| Exaggerated and abnormal compensation | | |
| Dilated vessels, disorderly proliferation of new vessels, and so forth | | |

rhages, and edema. This appears to be the most common mechanism.

2. If the infant is kept in oxygen, then the narrowing of the vessels may progress to actual ischemia. This would produce a tissue anoxia even though the oxygen supply is plentiful. Such a series of events would account for the lesions produced by Patz[14] in newborn animals which were kept in continuous high concentrations of oxygen.

The last mechanism operates in the occasional infant who develops some stage of retinopathy even though he has received no supplemental oxygen.

3. This mechanism would be one of direct anoxia rather than secondary anoxia and could be the result of respiratory infections or general diseases.

## Summary and Conclusions for Part II

1. Observations were made on 267 infants of whom 74 had some stage of the retinopathy of prematurity.

2. The great variability of the course of the disease is emphasized and some of these variable findings mentioned.

3. A great majority of infants (68 out of 74) were found to have developed the disease after oxygen supplements were stopped. Only one of these 68 developed the disease more than two weeks after removal from oxygen.

4. Oxygen therapy to 24 infants with a rapidly progressing disease brought a favorable response in each instance. Recurrences took place in 14 infants when therapy was stopped.

5. Pneumonia and other general diseases appear to be associated with the development of retinopathy in certain cases.

6. Retinopathy of prematurity is an anoxic disease rather than an oxygen-toxic one. Although the excessive use of oxygen supplements predispose to the disease, it is usually the rapid withdrawal of these supplements that precipitates the appearance of the retinal changes.

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## References

1. Bedrossian, R. H.: Paper presented to Section on Ophthalmology, College of Physicians of Philadelphia, April 16, 1953.
2. ———: A new aid in the examination of premature infants. Am. J. Ophth., **35**:1501, 1952.
3. Szewczyk, T. S.: Retrolental fibroplasia: Etiology and prophylaxis. Am. J. Ophth., **35**:301, 1952.
4. Michaelson, I. C.: Mode of development of the vascular system of the retina: With some observations on its significance for certain retinal diseases. Tr. Ophth. Soc. U. Kingdom, **68**:137, 1948.
5. Reese, A. B., Blodi, F. C., and Locke, J. C.: Pathology of early retrolental fibroplasia: An analysis of the histologic findings in the eyes of newborn and stillborn infants. Am. J. Ophth., **35**:1407, 1952.
6. Patz, A., Hoeck, L. E., and de la Cruz, E.: Oxygen administration in retrolental fibroplasia. Am. J. Ophth., **35**:1248, 1952.
7. Ryan, H.: Retrolental fibroplasia: A clinicopathologic study. Am. J. Ophth., **35**:329, 1952.
8. Crosse, V. M., and Evans, P. J.: Prevention of retrolental fibroplasia. Arch. Ophth., **48**:83, 1952.
9. Szewczyk, T. S.: Retrolental fibroplasia: Etiology and prophylaxis. Am. J. Ophth., **35**:301, 1952.
10. Cusick, P. L., Benson, O. O., Jr., and Boothby: Effect of anoxia and of high concentrations of oxygen on retinal vessels. Proc. Staff Meet., Mayo Clinic, **5**:500-02, 1940.
Ketty, S. S., and Schmidt, C. F.: The effects of altered arterial tensions of C $O_2$ and $O_2$ on cerebral blood flow. Clin. Invest., **27**:489-492, 1948.
Best, C. H., and Taylor, N. B.: The physiologic basis of medical practice. Baltimore, Williams & Wilkins, 1950, pp. 340-342.
Adler, F. H.: Physiology of the eye. St. Louis, Mosby, 1950, p. 262.
11. LaMotte, Wm. O., Jr.: Report of Second M and R pediatrics research conference. Retrolental fibroplasia., Columbus, Ohio, 1951, p. 26.
12. Hepner, W. R., Jr., and Krause, A. C.: Retrolental fibroplasia: Clinical observations. Pediatrics, **10**:433, 1952.
13. Ashton, N., Ward, B., and Serpell, G.: Role of oxygen in genesis of retrolental fibroplasia. Brit. J. Ophth., **37**:513 (Sept.) 1953.
14. Patz, A., Eastham, A., Higginbotham, D. H., and Kleh, T.: Oxygen studies in retrolental fibroplasia. Am. J. Ophth., **36**:1511 (Nov.) 1953.

# CAUSES OF FAILURE OF CATARACT OPERATIONS*

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In a survey of the results of consecutive cataract operations, including all of the complicated cases, I reported that, on the average, five percent of the patients failed to achieve 20/200 (6/60) or better central vision and thus had to be classified as failures.

In three to four of these five percent, there were irremediable associated pathologic conditions, in view of which the cases might be considered relatively successful; however, one to two percent of each series represented preventable total failures.

The percentages in both groups were greater for the one-eyed cataract patients, those who had previously lost one eye through trauma, disease, or surgery.

In this paper, I am chiefly concerned with the cases in which total failure could have been prevented. I will stress the occurrence of vitreous disturbance and loss, inflammation, infection, glaucoma, hemorrhage, secondary membranes, and their sequelae. These complications do not necessarily result in total failure, since most of the eyes can be salvaged, but some of these patients could have been spared the effects of the complications and the percentage of failures of cataract operations would have thereby been decreased.

## DIFFICULTY OF OPERATION AS CAUSE OF FAILURE

Difficulty of performance of the cataract operation by the surgeon may be considered a cause of failure.

When Daviel first performed extraction of cataract, his method was difficult compared with the ancient method of couching. Extraction through a relatively large corneal opening was resisted by other cataract surgeons for a long time because of the lack of knowledge, the difficulties encountered, the patient's reactions, and the poor quality of the sedative, analgesic, and anesthetic drugs. In this era, incisions were made in the lower portion of the cornea, chiefly because the patient, through reflexes, spasmodically cast his eyes upward.

The surgeon now has great advantages. Both the patient and his eye can now be kept quiet during the operation. Planned, delicate, precise maneuvers and manipulations can now be performed with minimal trauma to the eye and its tissues and the result is fewer failures and better, longer-lasting vision.

The surgeon may, however, develop a psychologic block and a spirit of defeat because he cannot do certain things in cataract surgery, as for example to separate the zonule. Some operators can do extracapsular surgery well but never seem to develop any confidence or ability in performing intracapsular extraction.

## PERSISTING DIFFICULTIES OF CATARACT OPERATIONS

Von Graefe improved and popularized the Daviel extracapsular extraction, but he and others who followed him experienced failures due to the presence of remnants of the lens capsule, the lens epithelium, and the normal lens cortex—the debris and toxic products of the cataract which were left in the eye.

Now the successful intracapsular extraction or removal of the lens in toto has lessened these difficulties in most cases, particularly in the group of immature cataracts but it has not solved the intumescent cataract problem nor the cases in which it seems almost impossible to prevent rupture of an abnormally thin and friable capsule.

In cases of intumescence, grasping the

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capsule with forceps for intracapsular extraction is difficult or impossible. The capsule may be thin, delicate, and easily ruptured with either forceps or suction cup. It may be thick and rubbery and possible to grasp only with the aid of a suction cup. If, in cases of intumescence, the zonule separates readily, the operation may be easy but, if it is resistant, then the more difficult maneuver of direct separation of the zonule is indicated.

It is usually best judgment to do a capsulotomy in cases of intumescent cataracts in young persons. Since the capsule is thin and fragile and the zonule is resistant, the intracapsular extraction causes too much trauma. With a capsulotomy, residual cortical material may be dissolved and absorbed without complication.

In cases of intumescent cataracts with rubbery capsules, however, when the cataracts are thickened because of senile or radiational degenerative proliferation of the epithelium and capsule, the lens should be removed in toto.

This is true also in cases of morgagnian cataract because of the toxic nature of the products of degeneration of such lenses. When the zonule in these cases is very weakly attached and the capsule is not easily grasped, it is better not to risk rupture of the capsule. Such cataracts may be expressed with the aid of an instrument applied to the exterior of the eye, the lower limbus of the cornea being the area of choice in which to begin the manipulations.

If there should be a rupture of the capsule in an ordinary case, it may be dealt with simply as an extracapsular operation and special effort may be made to remove all of the capsule and other remnants of the lens.

## A system of intracapsular extraction helps to avoid failure

It should be the aim of all cataract surgeons to develop their own systems of cataract surgery by which they can apply in sequence a progressive series of maneuvers according to indications so that they will not impose upon the eye the difficulties which develop with the use of a routine method of operation in every case.

In my own personal system, after the incision, I use a blunt instrument to test by palpation the eye, its pressure, and its tissues; then I apply point pressure to learn its resistance and reactions. Usually intracapsular forceps are then applied to the lens capsule and, by a combination of traction, rotation, and pressure, I quickly determine the condition and resistance of the zonular attachment.

If separation of the zonule does not occur easily, I do not continue ineffective maneuvers which may cause trauma. I shift to other maneuvers to initiate and further the separation of the zonule, usually by direct interference under direct visual control; by the safe, feasible method of stripping, separation, or disinsertion of the zonule from the upper equatorial portion of the lens.

This method has proved to produce less trauma to the eye. It has given excellent results.

## Factors involving operating team and hospital

The trained members of an operating team should include a competent assistant surgeon, who could take over and assume the responsibility of finishing the operation if the need should arise, and an akinesiologist —a physician who supervises the general condition of the patient and who provides the necessary sedatives and other agents which induce relaxation of the patient.

If the surgeon does not use certain techniques which are indicated because they appear to be too difficult; if he does not possess or use the proper instruments; if he overlooks the lack of proper care of his instruments; if he does not insist on proper sterilization; if he does not attend to the factors of arrangement and convenience in the operating room, he may be responsible

for elements which lead to failure.

Cataract operations done in unfamiliar surroundings, or when language, mental, or hearing difficulties prevent easy, correct and understanding contact between the surgeon and his assistants and the patient, may result in otherwise preventable accidents and failure.

There are a number of conditions in the operating suite which influence the surgeon, the staff, the patient and his eye during cataract operations and which may determine success or failure. It may well be that those who are not directly concerned with cataract operations have not appreciated the need for improvements in material conditions to effect an improvement in the morale of the eye surgeon and in the esprit de corps of his assistants.

The American College of Surgeons should set up a progressive minimum system of standards for eye operating and hospital rooms in keeping with the best that is available. Vision is priceless and, if only a few eyes which would otherwise be lost are saved, the cost of the improvements, their maintenance, and of keeping them up to date can be discounted quickly.

### Factors concerning the patient

There are certain factors concerning the patient—his physical and mental condition—which may lead to failure before, during, and after the cataract operation. Lack of proper preoperative nursing care, lack of proper sedation, analgesia, anesthesia and akinesia, development of morbidity during or after general anesthesia, hypersensitivity reactions to cocaine, synthetic local anesthetic agents, or adrenalin, excitement, inco-ordination, delirium, collapse, or syncope, lack of proper air in the closed rebreathing chamber—any or several of these factors may cause failure.

The behavior of the patient may prevent the surgeon from accomplishing the purpose of the operation. Continual motion of the eyes makes it very difficult to execute any planned maneuver. Muscular pressure exerted by the patient on the eye may cause accidents and the complications which follow. The patient's physical condition may be so poor that proper healing does not take place or infection occurs.

### Sedation, analgesia and anesthesia

Not all surgeons distinguish between drugs which are primarily sedative and depressant and those which are analgesic but possess some sedative effect. The early effect of many of the sedative drugs on certain patients—for example, the barbiturates—is excitation and exhilaration. Disorientation with uncontrollable motor actions may be an early or later manifestation. A drug may produce nausea and vomiting. This may occur because of hypersensitivity or an abnormal response to the drug or because of overdosage.

Failure of cataract operations may be due to insufficient or ineffective anesthesia. Procaine alone, either by infiltration or by block injection, does not always give sufficient anesthesia or local palpebral akinesia. Cocaine may produce serious reactions in certain patients. After orbital and retrobulbar injections there may be only partial extrinsic ocular muscle paralysis and the unaffected muscles may go into spasm and pull the eye into inconvenient and disturbing positions. The addition of hyaluronidase to the retrobulbar injection does not solve this problem, since the effect may not be as desired and since the volume of the orbital tissues is increased by the injection and by extravasation of fluid and blood which may occur unless severe manual pressure and massage are used for some time after the injection.

Even under general anesthesia, particularly with sodium pentothal or nembutal, general and orbital muscle spasm and rigidity may persist in the lighter planes of unconsciousness. Even the slightest manipulations of hyperalgesic tissues may set off severe spasms.

Irrigation of the conjunctival sac, may, if some of the fluid goes through the nasolacrimal duct into the nose and pharynx, cause

a laryngeal spasm which is most disturbing. Clogging or slipping of the intravenous injection needle or failure to give sufficient dosage to keep the patient sufficiently anesthetized may permit development of unconscious motor reflexes that could cause serious accidents during critical stages of the cataract operation.

### General curare akinesia with local anesthesia

The delicate precise maneuvers of advanced cataract surgery require a quiet eye and a quiet patient. Planned and carefully executed operations cannot be carried out in the presence of motion of the eye, particularly when muscle contractions are forceful, when the eye is turned up, when the patient squeezes shut the unoperated eye, when simultaneous contraction of all the orbital muscles imposes conditions of pressure on the globe. I am inclined to agree with Lancaster that the danger from spasm of the orbital cone muscles is greater than from spasm of the palpebral muscles.

Spasm and rigidity of the voluntary muscles usually develop as a deep basic fundamental reflex to emotion and to pain. Respiratory neurosis, particularly holding of the breath, produces venous congestion with increased pressure and volume of the blood in the uvea.

Many patients are apprehensive and worried, many are hyperalgesic, many fear the failure of the cataract operation, and, through their emotional disturbances, are doing their best to bring it about. The surgeon cannot relax when danger of extrusion of viscid vitreous is imminent, particularly when he thinks of the great and difficult complications which follow.

About 20 percent of cataract patients do not react well to sedatives, analgesics, or local anesthesia and it is these so-called "bad" patients who continue to give threat of failure or even disaster. In such cases, if there is no contraindication, such as myasthenia gravis, renal insufficiency, deficient cardiac or respiratory reserve, severe general hypersensitivity or allergy, the surgeon may order the intravenous injection of purified extract of curare in the form of Intocostrin, D-tubo-curarine, or Metubine in minimal dosage. It should be administered very slowly and titrated to the clinical end-point of orbital muscular relaxation. A desirable degree of general muscular relaxation is also produced.

Curare given in this manner has, in my experience, given satisfaction and a wide margin of safety. It has permitted surgery with good results such as could not have been achieved by other means. I repeat, however, the warning of the potent paralyzing action of curare; the need for knowing the drug and the patient, the careful, very slow intravenous administration; the constant check of the reactions of the patient; alert supervision to prevent and to correct even the slightest degree of anoxia.

The most important accident occurring during the operation for extraction of cataract is extrusion, escape, or loss of viscid vitreous. In a series of 600 cataract operations performed during a five-year period of research on and use of curare, the percentage of cases (including all types and all of the complicated cases) in which pathologic fluid vitreous was encountered remained the same, about two percent, after the use of curare as before.

General or total curare akinesia helps the surgeon, himself, to relax for he knows that he can perform delicate maneuvers that would be considered too difficult under ordinary conditions. The patient mentally at ease during the operation, often says later that he lost his fear that he would move and spoil the operation.

There is less postoperative reaction because the surgery is less traumatizing, hence the patient is usually quieter and less likely to rupture the incision, to prolapse the iris, or otherwise to interfere with healing.

### Eye conditions contributing to failure

#### Uvea

Developmental anomalies, inflammation, iritis, iridocyclitis, cyclitis, choroiditis, synechias, heterochromia, hypotony, secondary glaucoma, occlusion or seclusion of the pupil, essential atrophy of the iris, cysts of the iris are uveal conditions which may contribute to failure in cataract surgery.

#### Retina

Retinitis, retinopathy, degeneration of the macula, hole or cyst in the macula, degeneration of the choriocapillaris, hemorrhagic conditions, thrombosis, metabolic or arteriosclerotic conditions, and detachment produce a predisposition to failure.

#### Optic nerve

Retrobulbar neuritis, amblyopia, amaurosis, and atrophy may contribute to failure.

#### Ocular tension

Increased intraocular pressure may be due to primary glaucoma or may be secondary to the condition of the cataract which may be intumescent, enlarged, or hypermature.

Hypertension, in some cases, may be due to diabetes or hemorrhagic conditions, to thrombosis of the central retinal vein, neoplasms, epithelial ingrowth, to vitreous adhesions, uveitis, synechias, subluxation of the lens, traumatic cataract, extracapsular debris, incarceration of the vitreous, or to pupillary block by the vitreous.

Tests should be made to indicate the intraocular pressure before any cataract operation. The making of a limbus incision under conditions of increased intraocular pressure is fraught with dangers of uveal congestion, uveal hemorrhage, forward movement of the vitreous and its possible loss, and failure of the operation.

Hypotony with decreased intraocular pressure and fluid vitreous, ciliary body degeneration, and collapse of the eyeball upon the incision are important factors in the prognosis of failure of cataract operations done under such conditions.

#### Neoplasms

Tumors of the eye may be concealed by a lens opacity. All eyes in which there is faulty light perception or projection or in which there is no fundus reflex should be transilluminated to rule out neoplasms before any operation is performed.

### Preoperative indications of failure

When inconclusive or faulty subjective responses to tests for visual function denote faulty central form vision, faulty central light perception, faulty central color vision, or faulty peripheral form and light vision, complications are likely to occur and failure to restore vision by removal of the cataract is probable.

### Failures developing during operation

1. *Topical local anesthesia* may cause hypersensitivity reactions, drying and softening of the corneal epithelium, corneal abrasion, and ulcer formation.

2. *Soap detergents,* iodine, or other substances used in the preparation of the surgical field may get into the eye and cause irritation or chemical trauma.

3. *Injection for local anesthesia and akinesia* may result in subconjunctival, subcutaneous, or retrobulbar hemorrhage. Extravasation may occur even when a dull needle which does not pierce the veins is used. The injected fluid may cause the rupture of small venules. Rarely there may occur ischemic loss of vision through vascular spasm caused by adrenalin. Paralyses of individual muscles may result in unwanted deviations of the eye.

4. *Hemorrhage* may come from the incision, the iris, the ciliary body and choroid, or from beneath the choroid. It may be venous oozing or active arteriolar bleeding. It may result in hyphema, vitreous opacity, detachment of the choroid with damage to the

uvea and retina, or dreaded expulsion of the ocular contents.

5. *Incisions.* Faulty, shallow, irregular, or deep incisions may produce injury to the iris, ciliary body, or lens capsule. Luxation or subluxation of lens may occur during the incision.

6. *Faulty sutures* (insecure in the conjunctiva, or in the limbus and conjunctiva) which give improper apposition and coaptation, with overriding, distortion, and ineffective closure of the incision, may contribute to failure.

7. *Trauma* to the iris tissue may result in inflammation and synechias.

8. *Iris prolapse.* The lack of an opening in the periphery of the iris either by complete iridectomy or by peripheral iridectomy or iridotomy to permit egress of the aqueous from the posterior to the anterior chamber may contribute to iris prolapse.

9. *Accidental cutting* of the iris during the incision, surgical iridodialysis, or avulsion of the iris and injury to the lens capsule may occur during the iridectomy.

10. *Poor visibility* of the details in the anterior chamber may lead to failure. Elevation of the corneal flap and irrigation of the anterior chamber helps in visualization.

11. *Removal of blood* by sponges may leave irritating cotton fibers or synthetic sponge dust behind. The introduction of any foreign material into the anterior chamber or any chemical, traumatic, or thermal injury to the endothelium of the cornea may lead to failure.

12. *Rolling of Descemet's* membrane and eversion of an unsutured corneal flap interferes with healing.

13. *Vitreous presentation* due to a defect in the hyaloid and zonule, vitreous herniation, prolapse, escape, and incarceration are important causes of failure.

14. *Detachment of the choroid* due to external scleral trauma, to lowered intraocular pressure, or to choroidal trauma may prolong the convalescence and possibly produce failure.

15. *Detachment of the retina* may develop. Whether this is due to degeneration, to preexisting conditions, to changes in intraocular pressure, or to traction on the vitreous when it is adherent to the retina, it is a most important complication.

Any or all of these conditions, events, and accidents may convert what might otherwise be a successful cataract operation into an unsuccessful one.

### Condition and Reactions of the Vitreous

The condition and reactions of the vitreous are so important to success or failure in cataract surgery that a separate discussion is indicated.

Compared with the normal viscid vitreous gel, degenerated vitreous may be reduced to a semiviscid state, to a semifluid condition, or to complete fluidity.

There are various causes for development of opacities in the vitreous:

Cholesterol, calcium, or other organic and inorganic deposits; degeneration, shrinkage, and conglomeration of the vitreous framework and gel; degeneration and wandering of pigment cells and exfoliated pigment granules into the vitreous; extravasation and hemorrhage into the vitreous, leaving blood and blood products; presence of inflammatory cells and debris; development of a secondary membrane on the face of and into the vitreous; growth of fibroblasts and new blood vessels and contractile fibrous tissue in the vitreous.

Movement of the vitreous from its normal position is important. It may occur before the cataract operation, during the incision, at the time of the iridectomy, at the grasp of or the discission of the lens capsule, at the time of or after the delivery of the cataract, in the early postoperative period through voluntary muscle strain which may rupture the healing incision, at the time of the removal of the sutures, through any direct injury to the eye, through cicatricial contraction in the later period of resolution, and, finally, through degeneration.

The causes of extrusion, escape, or loss of vitreous in relation to failure of cataract operations may be listed as follows:

Contusion, compression, or penetrating trauma; the removal of a luxated or subluxated lens or cataract; the rupture of the hyaloid by any instrument or by pressure; aspiration by the suction cup; discission or removal of after cataract; the removal of sutures.

The patient may induce increased uveal congestion and pressure with loss of vitreous by respiratory neurosis; by orbital or orbicularis muscle spasm; by general muscle rigidity or hyperkinesia; by the strain of nausea, retching, or vomiting.

There are varying degrees of prolapse of the vitreous from its position behind the patellar fossa into the anterior chamber where it impedes the vascular circulation of the uvea or where it may press upon the iris or ciliary body and interfere with the circulation and exit of the aqueous humor from the eye.

When the vitreous is bulging into the anterior chamber and displacing from a fourth to a half of the aqueous, evidently it is in almost constant contact with the pupillary border. When it is surging into the anterior chamber and, at times (although most of the time), touching the corneal endothelium, there is a capillary film of aqueous between the vitreous and the endothelium.

When the vitreous is in constant contact with, in apposition to, or resting upon the corneal endothelium or when it is actually adherent to the endothelium, it may cause hydropic degeneration, edema, and opacity of the cornea, as well as, later, intractable increased intraocular pressure. When the vitreous actually plugs the pupillary opening, blocking the egress of the aqueous humor from the posterior to the anterior chamber, it may cause an embarrassing increase in intraocular pressure.

When it is incarcerated and adherent to the incision, it causes local corneal edema and opacity, traction on the iris and ciliary body, and on the deeper vitreous framework. Traction by the vitreous on previous pathologic adhesions to the retina causes retinal separation.

Any of these conditions of the vitreous can cause failure of the cataract operation.

### Congenital cataracts

Factors which contribute to the failure in operations for congenital cataract may be the presence of such associated congenital anomalies as corectopia, coloboma, megalocornea, persistent pupillary and hyaloid adhesions, or amblyopia. Progressive degeneration or continued inflammation or contraction of cicatricial tissue may also be adverse influences.

Operative complications include insufficient discission, improper or inefficient fixation of the lens during the discission, the cutting of the posterior capsule (with its attendant admixture of cortex and vitreous), large incisions of the cornea or limbus in patients who have not reached the age of co-operation, attempts to remove the mass of the cataract when the difficulties of protecting the operated eye against self-injury are evident. There also may be difficulties with the attached and resistant portion of the zonule in cases of congenital subluxation. Untoward reactions, infections, uveitis, iritis, synechias, occlusion of pupil, and other complications may lead to failure in the removal of congenital cataracts.

### Juvenile cataracts

Among the conditions influencing failure in operations on juvenile cataracts are:

Maldevelopment, amblyopia, strabismus, trauma, inflammation, and the difficulty of obtaining proper anesthesia and akinesia. The vitreous prolapse and escape which follow abortive attempts to do an intracapsular extraction too early. The vitreous is apparently under compression for development of the posterior segment of the eye until the individual is about 27 years of age.

Omission of preliminary discission be-

fore linear extraction unless the lens cortex and nucleus are sufficiently changed, development of glaucoma, proliferation of epithelial cells, uveitis, false membranes, synechias, occlusion or seclusion of the pupil—all are important complications in the juvenile group.

### Complications of traumatic cataract

The very nature and cause of traumatic cataract lead to failure of the surgery. The type and location of the injury influence the prognosis which may be particularly poor when there is traumatic degeneration of the ciliary body, implantation of epithelium, development of corneal or vitreous involvement, or luxation or subluxation of the lens. A retained foreign body may cause siderosis, chalcosis or some other reaction.

The presence of lens residue and phacoanaphylactia or sympathetic uveitis may lead to failure of cataract operation in traumatic cases.

In cases of developmental or traumatic dislocations of the lens, vitreous escape and loss are frequent. Evidence of other malformations, degenerations, or trauma are usually present.

### Senile cataracts

It is usually possible to give a fair prognosis in most cases of uncomplicated presenile and senile cataract because, in the greater percentage of elderly people who develop cataract, the balance of the eye remains in good condition.

The senile cataract usually retains the shape of the normal crystalline lens, its capsule is of normal thickness with no adhesions to the cortex, and the zonule is of average fragility or weakness of attachment to the equatorial region of the capsule.

The zonule in these cases should separate readily, if an intracapsular extraction is decided upon. All of the opaque cortical material can be removed easily, if extracapsular extraction is employed. The intracapsular technique is easily applied to most cases of mature cataract.

There are, however, unfavorable conditions of the lens in some cases of senile cataract. The cataract may be immature and have a large amount of sticky clear cortex in which case the intracapsular technique is useful. The cataract may be soft and small or it may be excessively large and sclerosed. It may be swollen or intumescent. There may be degeneration of the lens, resulting in the condition best known as morgagnian cataract. The capsule may be thick and rubbery or thin and fragile. The zonule may be excessively fragile or resistant. In all these cases, intracapsular extraction may be indicated.

### Extracapsular cataract extraction

Accidents and causes of failure during extracapsular extraction may be:

The injudicious use of the method in cases of immature cataract and in some cases of hypermature cataract.

An insufficient size of the limbus incision or an insufficient opening of the lens capsule for easy expression of the nucleus and cortex.

The failure to remove sufficient lens epithelium, which may proliferate and form pearls or hyaline cysts and conglomerates.

The failure to remove the nucleus or the mass of the lens cortex, leaving a Sömmerring's ring which may cause phaco-anaphylactic uveitis and increased intraocular pressure.

The rupture of the posterior capsule and hyaloid with a mixture of cortex and vitreous.

The prolapse and escape of vitreous.

The luxation of the lens or nucleus into the vitreous.

The presence of posterior capsular and cortical adhesions and opacities.

The frequent development of after-cataract which results when capsular, epithelial, and cortical remnants and debris are left in the eye.

The admixture of blood and products of inflammation to the remnants of the cataract combine to produce secondary membranes of

varying density and opacity which obscure the pupillary area and prevent the restoration of vision.

There are reasons for failure during the operations of discission or removal of after-cataract:

Too early interference.

Operations which are excessively traumatizing and which cause too much traction upon the ciliary body.

The presence of active, even though insidious, low-grade uveitis.

New inflammation or reactivation of an old process.

Development of new cicatrices.

Glaucoma.

Too great interference with the vitreous, new escape or incarcerations of vitreous, development of new opacities of the vitreous, contraction of the vitreous.

Infection.

Separation of the retina.

Any of these factors may negate the efforts made to clear the pupillary area of the after-cataract.

### Intracapsular cataract extraction

There are accidents and events which occur during intracapsular extraction which contribute to failure:

Injuries of the lens capsule by the knife, keratome, iris forceps, scissors, intracapsular forceps, or suction cup leaving remnants of the cataract.

Rupture of the lens capsule due to other causes.

Luxation of the lens by pressure at the time of the attempted application of the capsule forceps.

An inefficient grasp of the lens capsule.

Difficult, traumatic, or inefficient separation of the zonule.

Presentation or escape of vitreous before the grasp with the forceps or suction or at any time during the operation.

Aspiration of vitreous by suction.

Uveitis, glaucoma, and other complications.

### Postoperative factors

Some surgeons seem to be interested only in the meticulous conduct of the operation. Their failure to supervise the care necessary in the postoperative period to promote healing and prevent complications, as well as failure to examine for and prescribe proper correction of the aphakia, may contribute to unsuccessful results.

### Early postoperative complications

In the early postoperative period, lack of sedation and analgesia, lack of proper early mobilization of the patient, and lack of the proper diet, with the necessary vitamins and minerals, may lead to failure of the operation.

Incidental general infections, such as those of the respiratory tract, cardiovascular disorders, gastro-intestinal disorders, or urinary tract disorders may cause considerable trouble.

Psychic disorders, arteriosclerotic aberrations, drug hypersensitivity with dermatitis, shock reactions to fever therapy, all may induce other complications. Fear, apprehension, nervousness, insomnia, and asthenia in the postoperation period contribute to possible failure.

There are many things which may happen to the eye in the early postoperative stage to threaten success. The lids may become edematous as a reaction to trauma, to hypersensitivity, or allergy to drugs. The conjunctiva may show chemosis from the same causes. The cornea may become edematous or keratitis may develop.

The limbal or corneal incision may fail to seal because of lack of proper plasma, fibrin, fibroblasts, and formation of cicatricial tissue. Reopening of the incision is often caused by pressure when the early union is weak and when the sutures fail to hold.

A leaking wound and a flat anterior chamber may favor the development of permanent anterior synechias. Rupture of the incision also leads to prolapse of the iris, to fistulization and filtering cicatrix, to prolapse and loss of vitreous.

If foreign bodies, such as cilia, bits of rubber, flakes of metal, an acrylic lens implant, certain chemicals or antiseptics enter or are left in the eye, unfavorable reactions may develop.

Virulent infection of the eye due to such pre-existing local conditions as blepharitis, conjunctivitis, or dacryocystitis may lead to stitch abcess, corneal ulcer or abscess, hypopyon, abscess of the vitreous, endophthalmitis, panophthalmitis, orbital cellulitis, cavernous sinus thrombosis, and meningitis. Evisceration or enucleation of the eye may be the end-result of such infections.

Inflammation, iritis, plasmoid aqueous, cyclitis, uveitis, or plasmoid vitreous may result from low-grade infection, local or distant, from reaction of the eye to remnants of the cataract, to drugs, to trauma, or to foreign material.

Local or general vascular disease may be the reason for closure of the central retinal artery, thrombosis of the central retinal vein, for recurrent venous oozing, capillary bleeding, or active arteriolar bleeding. There may be external hemorrhage, hyphema, vitreous invasion, subretinal or subchoroidal extravasation with the dreaded expulsion of the ocular contents.

Glaucoma may have been present and recognized before the operation or it may develop after the operation.

In the early postoperative period, detachment of the choroid with a flat anterior chamber may develop because of trauma, transudation, or hemorrhage. More serious is detachment of the retina with disinsertion of the peripheral retina or the formation of holes or tears associated with retinal degeneration or due to the pull of abnormally attached vitreous.

Implantation or downgrowth of surface epithelium may lead to cysts or to complete epithelial lining of the anterior chamber. Epithelial downgrowth is the cause of intractable glaucoma and disastrous failure.

## Late postoperative complications

In the late postoperative period—that is, up to the time of complete resolution of the effects of the surgery—various developments contribute to failure.

Corneal epithelial and endothelial dystrophy may lead to intractable corneal edema and opacity. This may have been due to preexisting degeneration, to neurotropic disease, or the condition may have been induced by trauma. Keratitis sicca may be a disturbing factor.

Uveitis, particularly of the sympathetic type with greasy deposits on the endothelium, edema of the cornea, cells, and increased protein in the anterior chamber of the operated eye, calls for the most careful analysis and treatment because of the danger of the possible involvement of the fellow eye. I believe it best to enucleate an eye which develops these features plus faulty light projection and hypotony (or possibly hypertony) rather than risk the loss of the other eye.

Primary glaucoma may often reoccur or secondary glaucoma may develop in the late postoperative period. Vitreous degeneration, adhesions, and particularly vitreous block are important causes of trouble.

After-cataract may cause failure to restore vision. The procedures needed for the division or removal of after-cataract in an attempt to clarify the pupillary area may also be unsuccessful.

Iris pigment displacement and proliferation may cause opacities in the cornea or in the vitreous. A cataract luxated into the vitreous during attempted extraction always causes late trouble. Corneal opacities, cysts, staphylomas, irregular astigmatism, and other disorders due to trauma or faulty healing contribute to failure. Corneal transplantation is usually unsuccessful after cataract operations.

The lack of proper glasses for restoration of monocular and binocular vision and the loss of accommodation may add up to failure in the opinion of the patient even though his central vision might be 20/20 if he had correct lenses. Motor anomalies with diplopia, confusion induced by aphakic and anaphakic vision, or inco-ordination of two

aphakic eyes and the need for occlusion of one eye also rate failure.

The loss of the periphery of the efficient field of vision—that is, beyond the range of the glasses—with embarrassing bumping into people and things, faulty judgment of form and distance, projection, position, direction, and speed (and the resulting clumsy behavior) also are most disturbing.

Irritation and annoyance over prolonged and tedious adjustment to every-day contacts provide reasons for many complaints. Judged by their vehemence, it might be assumed that what the surgeon calls a great success with 100-percent central vision is actually a complete failure when the patient cannot adapt himself to his new organ of vision and cannot resign himself to an understanding attitude in regard to his limitations.

There is need for a careful review of results as judged from all viewpoints to determine the relative success or failure of cataract operations.

The medicolegal appraisal of the diminution of efficiency and function in unilateral aphakia requires further consideration.

The loss of the crystalline lens of one eye through traumatic cataract or even the loss of the whole eye does not necessarily mean loss of half of the visual efficiency of the individual. Evaluation must be made for the loss of function which goes with the loss of the crystalline lens of one or both eyes and which leads the injured person to regard as a failure any operation to remove the cataract.

## Summary and Conclusions

The causes of failures of cataract operations have been studied from a standpoint of prevention when the cause can be recognized. The percentage of total failure in which the vision is less than 20/200 (6/60) is about five percent of all types of two-eyed cataract patients, including all of the complicated cases. It is greater in the one-eyed group because of usually evident reasons.

The analysis of the failures in the average adult and senile group of cases cannot bring out any dependable relative statistics, but it is my impression that:

1. Disturbances of the vitreous are of prime importance as the cause of failure.

2. Inflammation and changes in the cornea and uvea, with the very rare development of sympathetic uveitis and the now fortunately rather rare pyogenic infection, are next in importance.

3. The after-cataract or secondary membranes and adhesions which form, particularly after extracapsular extraction.

4. Glaucoma, present before the operation, due to the pathologic condition of the eye and of the cataract or secondary to the changes which develop after the operation.

5. Degenerative, hemorrhagic, and proliferative conditions, including those of the cornea, vitreous, retina, and optic nerve and their vessels.

6. Finally, there are the cases of detachment of the retina and other classes of cases which are seen more rarely.

Various ocular and general systemic conditions of the patient, the acts of the surgeon and of his assistants, and the complications and accidents which contribute to failure in whole or in part have been discussed.

Cataract surgery is more difficult than it used to be, but the intracapsular technique results in fewer failures than the extracapsular and older methods. The surgeon now has many advantages—better knowledge, better sedative, analgesic, akinetic, and anesthetic agents, antibiotics and hormones, better equipment and instruments—and he should be better able to prevent failure in cataract operations.

Acting upon an analysis showing that the principal causes of failure were pathologic conditions of the vitreous, inflammation, infection, secondary membranes, adhesions, and glaucoma, discussion has been directed to:

1. Improvement in the preparation of the patient so that he and his eye may be relaxed and thus permit the surgeon to operate more skillfully and effectively.

2. Promotion of primary healing.
3. Prevention of inflammation and infection.
4. Use of the better and advanced methods of intracapsular extraction.
5. Recognition, prevention, and treatment of glaucoma.
6. Prevention of hemorrhage and degenerative changes.
7. Better and improved methods of postoperative care.

The importance of general or total akinesia with local anesthesia is stressed, since it has enabled me to reduce the incidence of surgical accidents and loss of viscid vitreous.

Analysis is made of the various complications which exist or develop in the eyes of the infantile, juvenile, adult, presenile, and senile groups of cataract patients and their bearing on the prognosis and the avoidance of failure of the surgical procedure.

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### References

Kirby, D. B.: Surgery of cataract. Philadelphia, Lippincott, 1950.
———: Use of curare in cataract surgery. Arch. Ophth., 43:678-693 (Apr.) 1950.
———: Curare and cataract surgery. Tr. Sect. Ophth., AMA, Chicago, 1952.
Lancaster, W. B.: The cataract operation: A study of details. Surg., Gynec., & Obst., 52:452, 1931.

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# AN ANALYSIS OF DEPTH FACTORS IN ANISOPIA AND ANISODOMINANCE*

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Certain unexplained collisions of airplanes or ships in formation could possibly be attributed to pilot failure from these two newly discovered types of defective depth perception.

## ANISOPIA

The first type, "anisopia" was discovered and named by Paul Cibis.[1] The depth error consists of apparent individual rotation of flat contrasting objects.

This vertical "venetian blind" effect can easily be demonstrated with a row of white cards pasted on dull black cardboard. Viewed from a distance of six feet with a gray filter before one eye, the homolateral edge of each card approaches while the other edge moves away. In the normal person, this phenomenon should be called the "anisopic stereoeffect"[1] or "irradiation stereoscopy."[2]

My preliminary note[3] explained that anisopia is not a simple entity. The apparent relative distance and rotation of plane contrasting surfaces depends on various factors: ocular dominance, relative luminance, size and distance of targets in the visual field, relative pupil size, relative retinal image size (aniseikonia), relative retinal image luminance (physical light) and brightness (perception), relative retinal image blur (with or without consequent loss of visual acuity), and, finally, habitual individual differences in selection of clues for depth judgment.

The relation of such factors to the depth perception of massive objects in space will be discussed here.

## ANISODOMINANCE

The second type of defective depth perception has been named "anisodominance."[3] Other clues to depth perception being equal, right-eyed individuals see the right one of two or more equidistant objects nearer, while left-eyed persons see the left one nearer.[4]

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TABLE 1

THEORY OF HOMOLATERAL PREDOMINANCE IN THE BINOCULAR FIELD

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| PART 1. Mixed dominance: | | | | | | | |
| Degrees peripheral vision: | 90–60 | 60–30 | 30–1 | Foveal | 1–30 | 30–60 | 60–90 |
| Participation of left eye: | 100% | 85% | 75% | 50% | 25% | 15% | 0% |
| Participation of right eye: | 0% | 15% | 25% | 50% | 75% | 85% | 100% |
| PART 2. Right eye dominance: | | | | | | | |
| Participation of left eye: | 100% | 75% | 65% | 49% | 15% | 5% | 0% |
| Participation of right eye: | 0% | 25% | 35% | 51% | 85% | 95% | 100% |

Since ocular dominance is practically universal, and its effect can be seen on anisopia targets, anisodominance takes first place in this discussion.

During the past two years, I found that many office patients see the Cibis target not rotated but simply unequal in distance. This target consists of two white 12-cm. squares, six cm. apart viewed against a black background from a distance of three meters.

Certain patients showed "anisopia" who did not possess stereopsis—which would be impossible. Patients with a unilateral central scotoma or visual defect almost always saw the target homolateral to the best eye nearer. The anisopic stereo-effect failed to explain the effect of a gray filter before one eye to produce apparent differences in distance of large self-luminous plane targets without venetian blind rotation.

Further study has revealed that anisodominance produced the discrepancy. The displacement of the homolateral target depends on the brighter appearance of the retinal images of a dominant compared to a recessive eye, and on the gradient of participation of the two eyes in the final brightness perception of objects in various parts of the binocular visual field.

The central binocular visual field is bounded on the right by a crescent visible only to the right eye, and on the left by a crescent visible only to the left. The comparative brightness of objects in these crescents would depend on ocular dominance.

Pugh[8] found that a recessive eye of normal visual acuity might require as much as 100 times more light for subjective equality with the dominant eye in a haploscope (amblyoscope). In right ocular dominance, an object in the right monocular crescent would appear brighter than a similar object in the left. Under certain conditions of background and contrast, the brighter object would also appear nearer.

A theoretical retinal participation gradient in a person with mixed dominance is shown in Table 1, part 1. In the left monocular crescent, 90 to 60 degrees from fixation, the left eye contributes 100 percent and the right eye 0 per cent to final brightness perception. Between 60 and 30 degrees, the left eye contributes about 85 percent, the right 15 percent, and so forth. Only in a small central area is the participation equal.

The theoretical change in gradient across the horizontal meridian in right ocular dominance is shown in Table 1, part 2.

Suppose that in the entire field, the recessive eye requires 10 times as much light to make objects appear as bright as they do in the dominant eye. Suppose that objects in the areas about 10 degrees on each side of fixation were to be compared in relative distance.

The right object would be perceived according to Table 1, part 2, by participation of the left eye 15 percent, brightness 1.0 and of the right eye 85 percent, brightness 10. The perceived brightness would be near the average seen by the two eyes (Fechner), which would be 15 × 1 plus 85 × 10 divided by 2, or brightness 433.

The other object 10 degrees to the left of fixation would similarly be the average of left eye 65 percent, brightness 1.0 and right eye 35 percent, brightness 10, which would be 208. Therefore, the right object would

appear twice as bright as the left one.

Other clues remaining equal, the brighter of two objects appears nearer. By irradiation, a brighter object produces a larger retinal or cortical stimulus. Other clues remaining equal, the larger of two objects appears nearer.

Because of the spread of the gradient across the binocular field fixation could be moved to either of the two objects, or to any position between them, with little change in apparent relative distance.

The figures in Table 1 were derived from experiments on my own binocular vision. The targets were three self-luminous 20-inch squares placed 10 inches apart in a frontal plane. Viewed from 15 distance, with a gray filter of 24-percent transmittance before the left eye, there was little apparent rotation of the squares.

With binocular fixation on the central square, the right square appeared 10 inches nearer and the left square 10 inches more distant. With fixation on the left square, the central square appeared 10 inches nearer, but the right square was nearer an additional four inches. With fixation on the right square, the central square appeared 10 inches back, while the left one appeared an additional four inches away. With fixation 20 inches lateral to the right or left square, there was less than three inches displacement. This might be due to loss of contrast and size sensitivity in the retinal periphery.

Vertical cylinder targets entirely eliminate the anisopic stereo-effect in favor of anisodominance. A cylinder appears the same to either eye regardless of individual axial rotation, yet it is equally sensitive to phenomenal anisodominance.

Rolled white typing paper cylinders 11 by 2 inches in size on dull-black paper background, or similar cylinders covered with black carbon paper on a white cardboard background make an excellent target, to be viewed from a six-foot distance. The gray filter before one eye makes the homolateral cylinder appear two inches farther away if they are white, two inches nearer if they are black.

This equality in excursion of white targets on black compared to black on white is true only of vertical cylinder targets. With Cibis targets, black on white targets are quite inferior. I suspect that a black cylinder target is a positive mass, free to move, while a black square against a white background suggests a negative entity, a hole in a frame. A background or frame is not as free to move as is a definite object, depending on past experience.

With the vertical cylinder targets, aniseikonic magnification before one eye will make the homolateral cylinder move away, whether it is white or black. The size clue to make the homolateral cylinder approach is suppressed in favor of the stereoscopic, which consists of crossed disparity of the left object, and uncrossed of the right in Figure 2.

The fact that, in phenomenal anisodominance (that induced in a normal by a gray filter), the cylinder target movement is opposite in white compared to black targets indicates that relative retinal image size and not intensity is the predominant depth clue. A gray filter could not reduce relative target intensity, if the target is already black. One could postulate that the white background moves back when reduced in intensity, leaving the black cylinder relatively nearer, but backgrounds are not free to move.

With black or with white cylinders, the gray filter would produce an encroachment of unstimulated retina onto stimulated area. The retinal image of a white target would be smaller, and the image of a black target would be larger. The resulting binocular perception is that the cylinder appears nearer on the homolateral side of the larger retinal imagery. More evidence for this will be given later in the description of experiments with targets objectively unequal in size.

Ames[6] confirmed the predominance of size over intensity as a clue to distance. He connected two balloons and a bellows so

that air could be transferred from one balloon to the other by movement of a lever. The balloons could be made to alternate in size from about five to nine inches diameter. From a distance of 20 feet, such size changes resulted in apparent reciprocal sagittal movement of the balloons a maximum of about two feet.

Lights behind each balloon were controlled by rheostats so that movement of another lever would produce alternate changes in balloon brightness. With the balloons equal in size, the brighter balloon would appear to move nearer by two feet.

These apparent movements could be exaggerated by addition of size to brightness, or reduced by subtraction. The nearer appearance of a large balloon of dim illuminance showed the predominance of the size over the brightness clue.

Phenomenal anisopia and anisodominance increase with higher target-background contrast up to the point of glare, which interferes markedly. Targets made by black patches on the window pane, or by black paper from which square patches have been cut do not show anisopia.

I have been unable to observe phenomenal anisopia or anisodominance at distances over 100 feet. This should not be surprising in the case of anisopia, because it depends on stereopsis which decreases with distance. Theoretically anisodominance could be noticed at any distance, given targets of certain size and contrast.

Both anisopia and anisodominance can be observed at great distances through binoculars. By the maximum distances at which anisodominance is noticed on targets of various size, I found that individual squares must be at least 24 minutes of arc visual angle. The distance between targets is not critical, but should be about half the diameter of a square.

### Aniseikonic disparity

Anisopia and anisodominance are produced by irradiation differences in corresponding retinal images. One might, as I did, jump to the conclusion that similar changes in retinal image size are produced by aniseikonic magnification to result in the "venetian blind" rotation of the Cibis target. The fact that such rotation cannot be observed calls for more explanation.

In anisopia and anisodominance, the edge of each retinal image may shrink uniformly, but the center of each retinal image remains in constant relative position to the fovea, and other images. This type of disparity in size of corresponding retinal images results in stereoscopic rotation of each object on its central vertical axis. There is no change in the position of one object compared to another.

In aniseikonic size disparity, each part of one retinal image is moved away from the fovea by a certain percentage. This makes a disparity of each part of each object with the corresponding part of the retinal image of the other eye. These relations will be discussed under Figures 1 to 3, so that the rotation of all objects in the visual field about the point of fixation in aniseikonia will be understood.

There is an important difference in the effect of aniseikonia and these new anomalies on targets in the frontal plane and targets in the sagittal plane. The same large self-luminous squares which do not move from the frontal plane in aniseikonia become exceedingly good test targets when placed in symmetrical lateral sagittal planes just within the binocular visual field 15 feet from the eyes.

A subject may move his eyes and head as desired to compare the relative distance of the two targets, while 0.10 percent aniseikonic difference will produce sufficient disparity. Such image disparity would extend the length of a meter stick one millimeter. Targets in this lateral sagittal position will not respond to a gray filter before one eye.

There is apparently an "either-or" relation of target surfaces in the frontal plane for anisopia and anisodominance, and in the sagittal plane for aniseikonia. A target in

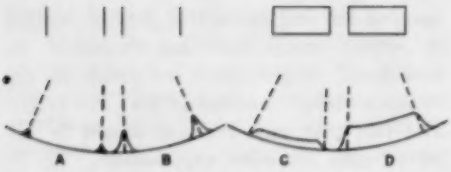


Fig. 1 (Miles). (A) represents linear retinal stimuli of certain separation with low illumination or with small blur circles. (B) shows that the separation is not altered by increased illumination or by larger blur circles. However, stimulated area (C) with low illumination may appear smaller than the same area (D) with increased irradiation.

an oblique plane will respond to either stimulus, but the gray filter effect predominates.

Figure 1 shows why a gray filter or a lens producing blur circles will not change the relative distance between two point images on the retina, or vertical lines. The length of the space A and the space B is determined by the centers of each stimulus, and not by the extent of irradiation or the blur circle. The effect on the retinal images of solid objects, on the other hand, is a difference in image size. The rectangular stimuli indicated in Figure 1 for retinal images C and D are equal in size, but the one producing D has greater intensity or larger blur circles. Image D is perceived larger because of irradiation or blur-circle stimulation of a larger retinal area.

Figure 2 shows the stereoscopic effect of aniseikonic magnification of the right retinal image of four vertical lines in a frontal plane. Fixation may be moved to any position, without change in the apparent rotation of the whole target. Although a gray filter would change the retinal image size of each line, there would be no change in relation of one line to another, and no apparent rotation.

The target in Figure 3 is identical, except that the vertical lines mark the edges of two surfaces, as in the Cibis target. The difference is illustrated again in Figure 1. The Cibis target will not respond to aniseikonia, but shows maximum rotation sensitivity to the gray filter. There is aniseikonic disparity present, which would, if effective, move the target surfaces to positions A and B. However, stereoscopic clues are suppressed in favor of the conflicting size and brightness clues, and the tendency to underestimate[7] the obliquity of familiar shapes.

Perhaps the apparent size change due to stereopsis, B in Figure 3 compared to A, is not entirely suppressed. In scale drawings, the proportion of A and B suggests an effect of size to make the two resume their original positions, A′ and B′.

The following experiment would tend to confirm this idea:

Pin two large business-size envelopes vertically two inches apart on dull black cloth. Note any effect of your own anisodominance. From a distance of six feet, observe the two envelopes with a gray filter of about 25-percent transmittance before one eye. The homolateral envelope will appear to move about 1.5 inches behind the other. Now, replace the left envelope by a 3 by 5 inch white card. The same gray filter before the left eye makes the card move back

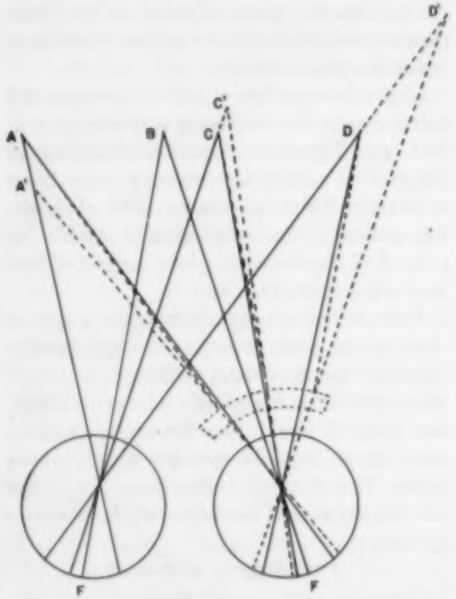


Fig. 2 (Miles). The apparent rotation of a series of vertical line targets in the frontal plane by aniseikonic magnification of the right retinal image.

about two inches, but before the right eye makes the large envelope move back only about 0.5 inch.

Such a difference in size of target pairs seems to be more important in anisodominance than it is in anisopia. I believe the difference is due to the fact that the "venetian blind" effect requires stereopsis, which is itself reduced by the effect of a gray filter before one eye.[8]

The same loss of stereoscopic acuity explains the predominance of size and brightness clues over stereoscopic. Increased size of blur circles from any source in one eye has a similar effect to reduce stereoscopic acuity, and will produce phenomenal anisopia and anisodominance of a type opposite to that from a gray filter.

### Anisopic disparity

In contrast to the effect of magnification on the Cibis target, Figure 3, the effect of a density filter is illustrated in Figure 4.

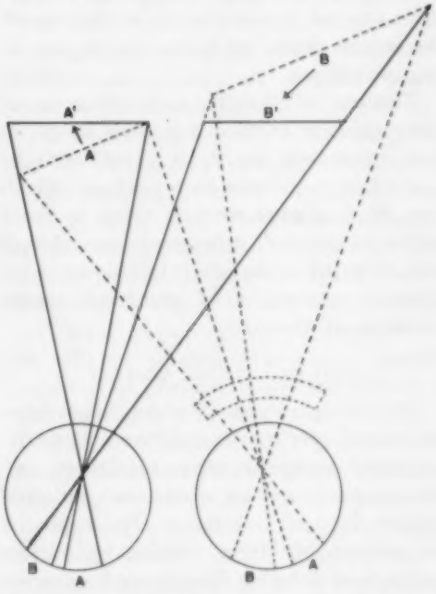


Fig. 3 (Miles). Here the same vertical lines represent the edges of two flat targets (A′) and (B′). The stereoscopic disparity present would cause apparent movement to positions (A) and (B), but is suppressed in favor of size clues.

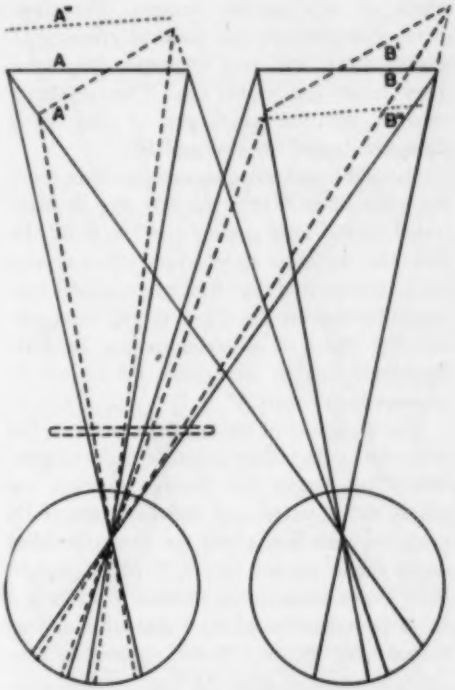


Fig. 4 (Miles). When a gray filter is placed before the left eye, flat targets (A) and (B) appear to be in the position (A′) and (B′) from stereoscopic clues. An additional displacement to (A″) and (B″) is produced by anisodominance.

A and B represent the Cibis squares in the frontal plane. Because of the gray filter in dashed lines before the left eye, each retinal image on that side is reduced equally at both horizontal edges. The vertical extent of such images is not significant in stereopsis, except possibly under other conditions producing Ogle's induced size effect.

Notice that the size changes in the left retinal image could have no relation to the position of the fovea, which could be directed anywhere in the target area without a change in disparity. The disparity is from the encroachment of unstimulated retina on stimulated, and is not aniseikonic.

The effect of this disparity on objects A and B is shown in Figure 4 by the dashed lines arising from the newly diminished

edges of left retinal images. Perceived distance depends on the point of crossing of dashed lines and the corresponding solid lines from the right eye. The resulting anisopic rotation of targets A and B is shown in dashed lines A′ and B′.

The additional anisodominance effect from the gray filter before the left eye is illustrated in the final positions A″ and B″. In this case, the same stereoscopic effect of size which neutralized the effect of an aniseikonic magnification on the Cibis target, exaggerates the effect of anisodominance. In scale drawings, due to stereopsis, the object B′ appears larger than A′.

The weakness of the anisopic rotation clue is shown by its failure in single plane targets. The Cibis target for testing anisopia requires two squares, and three are better. To compare aniseikonia and the new anomalies on a single square target, I photographed three equal translucent squares to make a 3 by 4 inch lantern slide. Polaroid film was placed over the two lateral squares to conform to a pair of polaroid separation glasses.

When the three squares were projected on an aluminum screen at 15 feet, the left square was visible only to the left eye, the middle square to both eyes, and the right square only to the right eye. One percent or more of aniseikonic magnification would move the homolateral white square nearer, being a pure size clue to distance.

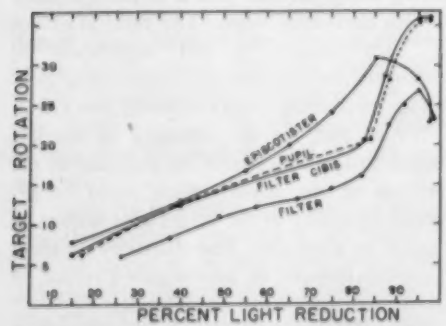


Fig. 5 (Miles). Graphs show that various methods of reducing retinal light intensity are equal in anisopic stereo-effect.

Aniseikonic disparity acting on the binocular central square should move its right edge back, its left edge forward. Instead, the central square remained in a frontal plane. At first it moved an equal distance nearer with the right square, then it resumed an intermediate position.

When a gray filter was placed before the right eye, the right square went back. However, instead of anisopic rotation of the binocular central square, it again remained in the frontal plane and moved with the right square, finally taking an intermediate position. With or without the additional monocular squares, aniseikonia or anisopia induced in normal eyes will not produce rotation of a single square target.

This failure may be an example of the Thouless "phenomenal regression"[7] which is characteristic of human binocular vision, and apparently depends on experience. A face which is actually rotated 20 degrees from a frontal plane, appears to be only 10 degrees averted. A coin may lie 40 degrees off the frontal plane, but appears to be only 20 degrees oblique.

Thouless believed this underestimation of the rotation of surfaces a possible danger in fast automobile traffic. It should also be studied in connection with reading difficulties. If a printed sheet is tilted to favor vision of one eye, it becomes more oblique and distorted to the other. In reading, a reciprocal suppression of peripheral images would be of advantage.

### Other anisopic stimuli

The anisopic stereo-effect can be produced in normal eyes by three different methods: unilateral change in image brightness, unilateral change in blur circles, and unilateral change in dark adaptation. The similarity in amount of target rotation by various methods of reducing illuminance for one eye is shown in Figure 5.

All data are mine except the line "Filter Cibis" which represents an average of several individuals reported in his article.

Whether light is reduced by episcotister (a rotating sector disc) or by artificial pupil, or by a series of gray filters of known transmittance, the amount of rotation of the Cibis target remains proportional to the illuminance.

In some individuals, there is a surprising difference in the anisopia produced by a stenopeic slit placed vertical compared to that produced with the slit horizontal. This worried me for some time, because it is not related to existing astigmatism.

In monocular vision of a perfect square in the frontal plane, an axis 90° stenopeic slit produces a rectangle elongated vertically, while an axis 180° stenopeic slit makes it horizontal. Since horizontal disparity is an effective stereoscopic clue, and vertical is not, considerable difference should be expected. However, displacement of the Cibis target by the stenopeic slit in axis 90° compared to axis 180° can be made equal by proper selection of sphere in a trial frame. The sphere induces a certain amount of accommodation or miosis which eliminates a difference of spherical and chromatic aberrations in the two meridians.

There remains for discussion the effects on the Cibis target of plus and minus sphere. Cibis reported correctly that plus sphere before one eye made the homolateral square appear to approach, and that minus sphere made it recede. However, he interpreted this difference to be due to magnification of the aniseikonic percentage type. Since aniseikonia will not produce phenomenal anisopia, the effect of plus and minus sphere must be explained in another way.

In tests on patients under cycloplegia, I found that either plus or minus sphere before one eye made the homolateral square approach. The stimulus is therefore not aniseikonic disparity, but the same type of encroachment of stimulated upon unstimulated retina as is produced in reverse by a gray filter. Blur circles from either plus or minus spheres enlarge the perceived retinal image, and the amount is equal.

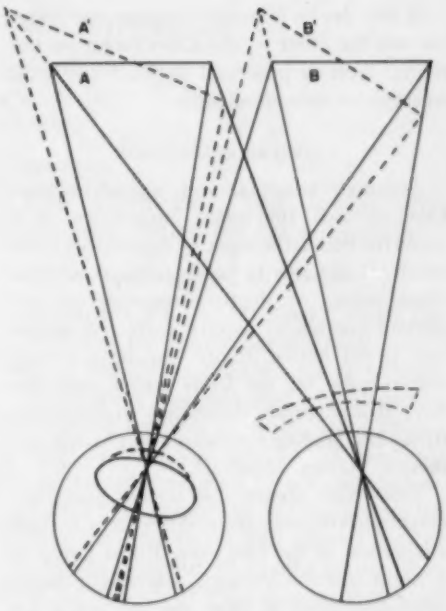


Fig. 6 (Miles). Excess minus sphere before the right eye causes both eyes to accommodate. While the right retinal image remains sharp, the left one shows blur circles and expansion, which is from irradiation, not magnification. Under cycloplegia, apparent target rotation would be in the opposite direction.

Figure 6 illustrates how a minus sphere before the right eye without cycloplegic can produce the same anisopic effect as would a gray filter. Both eyes accommodate, but the right retinal image remains sharp and approximately equal in size, while the left one blurs.

The expansion of left retinal images from blur circles is indicated by dashed lines, which projected form the stereoscopic clue to rotation of targets from A and B to A′ and B′.

Under cycloplegic, minus sphere before the right eye would produce blur circles in the right but not the left retina. The consequent displacement of the Cibis target would be in the opposite direction. Such lenses must be more than 0.75 and less than 1.75 diopters in power. Stronger lenses eliminate stereopsis.

If any device is used to change one image but not the other of the Cibis target on one retina, there is produced one-half the usual anisopia or anisodominance.

### Clinical evaluation

Although anisopia and anisodominance have obvious functional importance, it is doubtful that asthenopia or discomfort could result. It remains to be determined whether these errors of depth perception are important enough to require corrective unilateral tinted lenses. Pilots who have considerable error on the Cibis target, and who have demonstrable difficulties in formation flying and landing operations, might find corrective glasses beneficial.

Tests have shown that serious space disorientation results from differences in light adaptation in the two eyes. Pilots flying on a night mission through searchlight beams were instructed to close one eye for a few minutes. When the eye was re-opened, there was not only considerable discomfort from glare, but there was inability to keep the plane on course until the eye regained its adaptation. It is very easy to demonstrate anisodominance under such differences in light adaptation.

### Summary and Conclusions

Anisopia is an anomaly of binocular depth perception in which the retinal image of one eye is different in intensity or focus, causing an apparent rotation on each central vertical axis of flat objects in a frontal plane within certain limits of size, separation, and contrast.

Anisopia has considerable theoretical importance, but is limited in distance by stereopsis. It is opposed by the Thouless effect, by glare, by object shape, and is less important in case of dark objects against a bright background.

Anisodominance is an anomaly of binocular depth perception which is related to ocular dominance or to unilateral defects in retinal image intensity or focus, but instead of apparent rotation of individual objects, it produces simple differences in perceived object distance. Other clues to distance being equal, right-eyed individuals see the right one of two or more equidistant objects nearer, while left-eyed persons see the left one nearer.

Anisodominance may prove of considerable functional importance because it does not require stereopsis. While there are limitations in size, separation, and contrast of targets, there is probably no distance limit. Objects do not have to be flat, or white, but can be any shape or color.

Experimental trial of glasses which neutralize existing anisodominance is indicated in pilots who have considerable difficulty in formation flying or landing operations.

*640 South Kingshighway (10).*

### References

1. Cibis, P. A.: Anisopia and perception of space. J. Optic. Soc. Am., **41**:676-683 (Oct.) 1951.
2. Ogle, K. N.: Letter to the editor. J. Optic. Soc. Am., **42**:142, 1952.
3. Miles, P. W.: Anomalous binocular depth perception due to unequal image brightness, Arch. Ophth., **50**:475-478 (Oct.) 1953.
4. Scott, R. B., and Sumner, F. C.: Eyedness as affecting results obtained with the Howard and Dolman depth perception apparatus. J. Psychol., **27**:479-482, 1949.
5. Pugh, M.: Brightness perception and binocular adaptation, Brit. J. Ophth., **35**:134-142, 1951.
6. Ittelson, W. H.: The Ames Demonstrations in Perception. Princeton, N.J., Princeton University Press, 1952.
7. Thouless, R. H.: Phenomenal regression to the real object. Brit. J. Psychol., **21**:339-359, 1930-31; **22**:216-241, 1931-32; Nature, London, Sept. 3, 1938.
8. Verhoeff, F. H.: Effect on stereopsis produced by disparate retinal images of different luminosities. Arch. Ophth., **10**:640-645, 1933.

# CLINICAL PATHOLOGIC CONFERENCE

From the Laboratory of
PARKER HEATH, M.D.
*Boston, Massachusetts*

## CASE E-49-364

### HISTORY

A woman, aged 72 years, gave a history of marked loss of vision in the left eye since the day before admission to the hospital. Ten months before, her physician had given her drops for "iritis" in this eye.

### EXAMINATION

On examination, vision was: O.D., 20/20; O.S., light projection. Intraocular pressure was: 80 mm. Hg (Schiøtz). The right eye was clear except for minor peripheral lens opacification. The left eye showed a steamy cornea; anterior chamber of moderate depth. Light projection uncertain. Transillumination demonstrated no shadows.

### TREATMENT

One-percent pilocarpine and one-half-percent eserine were used frequently and gradually brought the intraocular pressure down to 26 mg. Hg. However, within two weeks, the intraocular pressure again became elevated to 60 to 70 mg. Hg. Enucleation was advised, but refused. An iridencleisis was done in the left eye during which some loss of pasty material occurred.

### SUBSEQUENT HISTORY

The intraocular pressure in the left eye stayed down after operation. Three months later the other eye, the right eye, developed iritis, but retained vision near 20/20. Vision in the left eye was sight projection. Both eyes were painful. The right eye became increasingly tender, congested, and showed numerous large and small brownish keratic precipitates. Posterior synechias formed. The left eye was congested, painful, and an anterior synechia spread from the iris inclusion.

### TERMINAL

One month later, four months after iridencleisis, the left eye was enucleated.

### DIFFERENTIAL DIAGNOSIS

*Discussion by Dr. M. King.** From this history one can summarize the ocular problems of this 72-year-old woman as follows:

The left eye was congested with glaucoma, the clinical features of which were steamy cornea, an anterior chamber of moderate depth, transillumination free from shadow, and poor light projection. We learn from the history that the recent and current loss of vision was preceded 10 months before by at least one episode of inflammation, diagnosed as iritis and so treated.

It is now our problem to classify the glaucoma.

When there is a unilateral glaucoma of this severity, with intraocular pressure of 80 mg. Hg (Schiøtz), a secondary type is immediately suggested. Secondary to what? The first thought is an angle block related to uveitis or iritis.

On treatment consistent with this diagnosis (the use of miotics), the patient did well, so far as the pressure was concerned, for a short time. The surgeon must, however, have suspected there was little hope for the eye, since he advised enucleation. But the patient had other ideas. So an iridocyclitis was offered as a compromise and accepted.

It is probable that cells in the anterior chamber were not seen or were masked by the corneal opacification and that uveitis was not thought to be significantly active. However, during the operation a "pasty" material escaped. Is this an incidental episode or does it tell us important news? I think the latter.

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* Surgeon, Massachusetts Eye and Ear Infirmary.

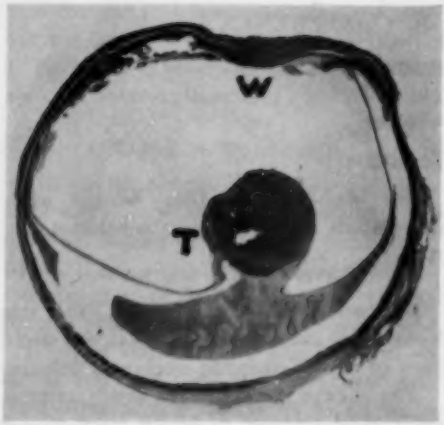


Fig. 1 (Heath). Calotte. (T) Malignant melanoma which arose from the choroid, separated retina. (W) Iridencleisis wound. Anterior chamber largely obliterated; thickened choroid.

Three thoughts regarding this "pasty" material come to mind. It may be: (1) Thick hypopyon exudate, (2) vitreous, (3) lens substance.

The escape of hypopyon exudate would benefit the patient and would suggest to the surgeon to back out of a "hot eye." Vitreous escape would tell him that there was vitreous ahead of the lens which, perhaps, was dislocated, probably by trauma. An escape of lens substance would suggest a recent lens injury (surgical); or it might be related to lens sensitivity, so-called phaco-anaphylaxis. This latter situation would call for removal of the bulk of the lens cortex.

Since we do not have a definite description, we must speculate, and I am going to assume that the "pasty" substance represented inflammatory by-products, not visible because of the cloudy cornea and the cornea could not be cleared by glycerin.

At once, there is criticism of a decision for surgical intervention by an inclusion operation (or any operation other than enucleation) in an eye in which only remnants of vision remained. This criticism, looking backward, may be justified. But remember the patient was offered the relief of enucleation and refused it.

The subsequent postsurgical history is of suggestive interest. The increased intraocular pressure, previously unrelieved by miotics or made worse by them, was relieved completely by the iridencleisis procedure. This apparent happy state lasted three months only. Thereafter, the left eye was congested, painful, and synechia formations were noted to arise from the included iris. The outstanding development was, however, in the other eye—it became painful and presented definite signs of iritis with pigmented keratic precipitates, while retaining good vision. This would seem to indicate the presence of sympathetic ophthalmia. The time and clinical appearances were consistent. The patient's age was not out of line.

Another month was wasted before the patient would agree to enucleation. This suggests that the pain was not too severe and that the visual acuity of the right eye was not particularly impaired. All of this is consistent with the findings in sympathetic uveitis.

In my opinion, therefore, this patient had a unilateral glaucoma secondary to uveitis of unknown origin; an iris inclusion operation was followed by sympathetic ophthalmia. We must consider in this case that the uveitis

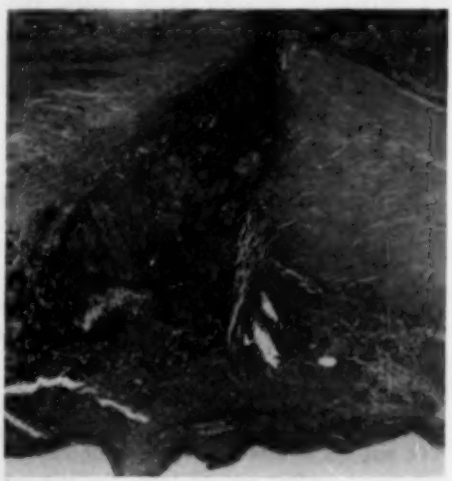

Fig. 2 (Heath). Iris incarceration in corneal wound; clumping and phagocytosis of pigment.

Fig. 3 (Heath). Sympathetic granulomatous choroiditis; many epithelioid and giant cells.

could arise from an intraocular neoplasm—a necrotic malignant melanoma. In this connection, the negative transillumination is not very reliable.

*Question from the audience.* How about an intraocular foreign body?

*Dr. King.* There was no history of an injury and no X-ray report was given. However, a foreign body as the source of the inflammation should be considered, and probably rejected.

### Diagnoses

*Clinical diagnosis.* Uveitis, secondary glaucoma, iridencleisis operation, sympathetic ophthalmia.

*Dr. King's diagnosis.* Unilateral uveitis with secondary glaucoma, postsurgical sympathetic ophthalmia. Possible alternative diagnosis—necrotic malignant melanoma with uveitis and secondary glaucoma.

*Pathologic diagnosis.* The principal features of the ocular pathology presented by the case are:

1. Moderate-sized malignant melanoma arising from the choroid, epitheloid-cell type, without evidence of necrosis and with slight reticulum formation.
2. Diffuse low-grade iridocyclitis.
3. Secondary cyclitic cataract.
4. Extensive separation of the retina with degenerative changes.
5. Perforation of globe (surgical); iris-incarceration operation.
6. Well-advanced typical sympathetic uveitis.

### Comment

*Dr. Parker Heath.* Historical evidence is given and anatomic evidence exists that the uveitis was of some duration, antedating the iridencleisis. On occasion, secondary glaucoma operations have to be done upon eyes which exhibit some evidence of uveitis.

As was suspected, the patient showed a full-blown sympathetic disease of the uvea, and in addition, a malignant melanoma. The latter, however, seemed unrelated to the sympathetic disease in view of the lack of necrosis and the strong evidence of anterior-segment correlation with the histopathology presented.

The need for suspecting the presence of

Fig. 4 (Heath). Extensively separated retina; "dragged" nervehead; heavily infiltrated choroid.

a malignant melanoma, as mentioned by Dr. King, in an eye with uveitis and unilateral glaucoma deserves emphasis. About 40 percent of such eyes are enucleated without a supportive clinical diagnosis.

The course of events in this case was: Unilateral, low-grade iritis with development of cyclitic cataract, low visual acuity and secondary glaucoma. The fairly sudden relative loss of vision reported by the patient was probably due to the malignant melanoma promoting a sudden extension of the retinal separation. At the time of iridenclesis, lens rupture caused escape of hypermature broken-down lens substance. After some months sympathetic uveitis developed.

A proved relationship cannot be established between the malignant melanoma of the choroid and the older, diffuse uveitis or the more recent, full-blown granulomatous sympathetic form.

The lesions in this case probably developed in the following sequence: (1) Malignant melanoma; (2) diffuse iritis, cause unknown; (3) extensive separation of retina due to tumor; (4) cyclitic cataract (liquefaction of cortex); (5) iridencleisis operation (lens capsule rupture); (6) sympathetic uveitis.

*243 Charles Street (14).*

## Ophthalmic Miniature

To this we may add another fact, stated by Dr. Priestley, with respect to the effect produced on the human eye by the use of magnifiers, and by a close attention to minute objects, a fact which seems to show that habitude, whilst giving an acquired facility, also diminishes the power, at least in process of time; for he observes, that Mr. Baker, an active member of the Royal Society, and who was famous both for his skill in microscopes, and for his extraordinary expertness in managing them, took the charge of examining some of the smallest globules for magnifying, which had ever been made, and which were sent to the Royal Society by Di Torre, of Naples, in the year 1765. Their size was extremely minute, for the largest had a diameter of only two points, Paris measure, and was stated by the maker to have the power of magnifying the diameter of any object 640 times; whilst the second was stated to be of the diameter of only one point, and to have a magnifying power equal to 2,560.

Of these, however, Mr. Baker could make no use, as even with the one of smallest power he was not able to examine any object with satisfaction; and in his account of the experiment, he expresses a doubt that his eyes must have been injured by the experiment, unless the previous use he had made of microscopes had, in some measure, saved him from the ruinous consequences that must have attended others in the examination of them, adding, that he believed there were few persons who would not have been blinded by it!

*The Art of Preserving the Sight Unimpaired to an Extreme Old Age.*
H. Colburn, London, 1816

# NOTES, CASES, INSTRUMENTS

## A NEW LENS FORCEPS*

WILLIAM J. MCGANNON, M.D.
*Lakewood, Ohio*

Cataract surgery is sometimes complicated by the lens slipping from the grasp of the capsule forceps when it is partially extracted. The lens capsule will sometimes sustain a tear under such conditions. Reapplication of a lens forceps or erisophake will then frequently result in an extracapsular cataract extraction. The capsule must then be removed at a variable risk or be left behind for absorption. (fig. 1).

The lens forceps here presented was designed to be utilized in such cases. The lens and capsule may be lifted out in toto as

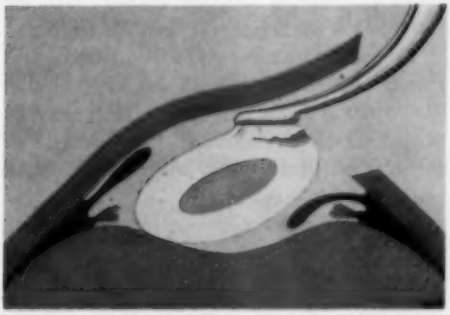

Fig. 1 (McGannon). The partially extracted lens may slip from the grasp of the lens forceps.

opposed to drawing out the lens minus the capsule which is frequently the necessary method of removal by any instrument grasping the anterior lens surface alone. (fig. 2).

The smooth anterior and posterior gripping surfaces of the lens forceps holds the lens securely, preventing slippage into the posterior chamber. The small steel brake of the forceps prevents the lens from being compressed too tightly and the lens is lifted out rather than pulled or drawn out, without the complication of the lens capsule being

Fig. 2 (McGannon). A new lens forceps.

Fig. 3 (McGannon). The new forceps in use.

torn. However, if the capsule has already been partially torn by a capsule forceps or erisophake, the lens and capsule still can be removed together.

The jaws of the forceps fit over the surface of the lens and capsule, compress the capsule and lens together, and lift it from the anterior chamber. An extracapsular extraction may be avoided by this procedure even when the lens capsule has been partially torn (fig. 3).

*14597 Madison Avenue (7).*

* Instrument made by Storz Instrument Company, Saint Louis, Missouri.

## TECHNIQUE OF PREPLACED SUTURES IN KERATOPLASTY*

J. JUNCEDA AVELLO, M.D.
*Oviedo, Spain*

Since 1824 when Reissinger made his first and unsuccessful corneal transplantation, this operation has passed from the experimental phase, during which the names of von Hippel, Filatov, and Castroviejo became especially well known, to that of daily prac-

* From the Hospital Provincial Oviedo. Presented at the 30th Congress of the Spanish-American Ophthalmological Society.

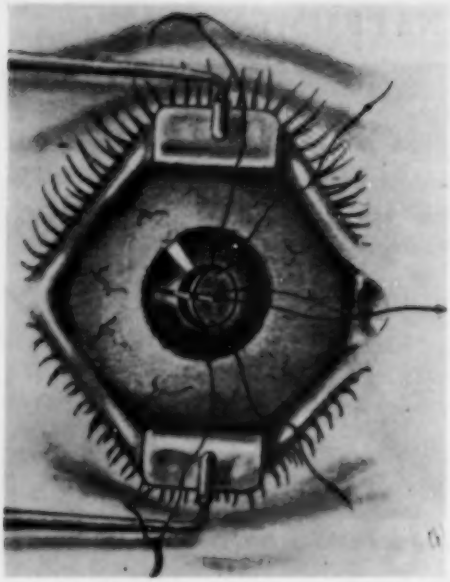

Fig. 1 (Junceda). Placing the sutures in the donor transplant.

tice in many of the great ophthalmologic centers of the world. However, its use is not as widespread as it deserves to be for:

1. In spite of establishment of eye-banks, there is still difficulty in some areas in obtaining donor eyes.

2. Most techniques for this operation demand special instruments which, for some ophthalmologists, are obtained only with great difficulty. For this reason, many neglect the operation, forgetting that it is more simple than many operations which they perform regularly.

3. Difficulties encountered in suturing the donor transplant into the recipient cornea have caused many surgeons to shun this operation.

In order to do away with the two last-mentioned disadvantages, I have evolved a technique of preplaced sutures which, in my hands, has not only lessened the difficulties encountered in the operation but has also resulted in less trauma to the recipient eye and, therefore, in a higher percentage of successful cases.

### Description of technique

1. After the donor eye has been trephined but before the small tags of Descemet's membrane, which almost always still hold the transplant to the neighboring cornea, are severed, three sutures—one at each end of the vertical diameter and one at the temporal end of the horizontal diameter (fig. 1)—are placed through half the thickness of the transplant.

2. The fourth stitch is placed through the very edge of the nasal end of the vertical diameter. Knots are tied so that the sutures will not slip through the transplant.

3. After the recipient cornea has been trephined—but for half its thickness only—the furrow of the incision is marked with fluorescein or mercurochrome and the uppermost suture in the transplant is passed through the upper part of the recipient cornea; then the lower; then the nasal and then the temporal.

These stitches must go from the transplant through the cornea (fig. 2) and back through the cornea into the transplant. They must be placed no deeper than half the thickness of the corneal parenchyma which is the depth of the trephination.

4. The transplant is put to one side and the sutures are pulled back and out of the

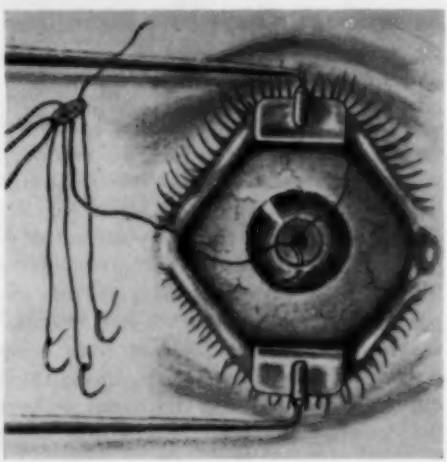

Fig. 2 (Junceda). Placing the sutures from the transplant through the recipient cornea.

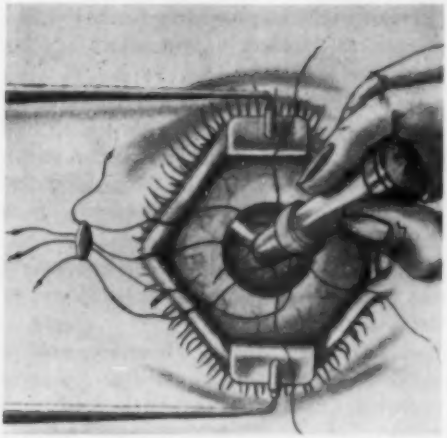

Fig. 3 (Junceda). Completing the trephination of the recipient cornea.

way in such a manner that the edges of the marked furrow of the trephine incision through the recipient cornea are pulled half way apart. Trephination of the recipient cornea (fig. 3) is then completed and the corneal plug is removed. Care should be taken not to cut the preplaced sutures.

5. The preplaced sutures are then tied, beginning at the top, then the bottom, then the horizontal ones (fig. 4).

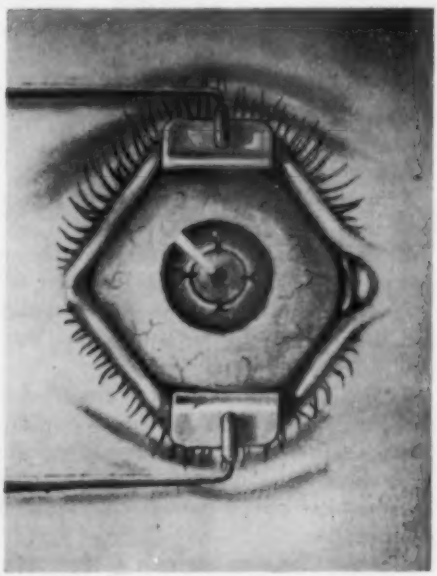

Fig. 4 (Junceda). Suturing completed.

### Discussion

This technique has the following advantages:

1. It is possible to do this operation without special instruments, since the sutures are placed before the recipient eye is completely opened.

2. The operation is performed with a minimum of trauma for it is unnecessary to touch the periphery of the recipient cornea with forceps.

3. Since the stitches are placed through half of the corneal thickness only, apposition is excellent.

4. The time of operation is greatly reduced.

5. During the operation, no pressure is needed and no extra stitches have to be placed.

*Hospital Provincial Oviedo.*

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## BAGGY EYELIDS

M. I. Steckler, M.D.
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Baggy eyelids, a common condition and the concern of women through the ages, is only occasionally mentioned in the literature. Ophthalmic surgeons up to the present time have paid little attention to this important cosmetic problem.

Schmidt-Rimpler,[1] in 1899, reported a case in which a mass of fat continuous with the infraorbital fat was found to be herniated through a weak orbital septum of the lower lid.

Kestenbaum,[2] in 1928, described the removal of these small pouchings of fat through a skin incision with traction of the skin toward the outer angle of the eye, with a good cosmetic result.

### Causes of baggy eyelids

1. Edema, essential or cause undetermined,[12] is rare. One such case in an army

nurse, aged 36 years, showed severe involvement of both eyelids. The skin was tissue-paper thin and protruded fully one-half inch or more forward, making the patient very unsightly. This patient had received many thorough work-ups without the cause being discovered. Treatment was unsuccessful.

2. Diminished muscle tone.

3. Vasomotor states.

4. Allergic responses.

5. Atrophic changes in the epidermis or subcutaneous tissues.

6. Familial traits.

7. Herniation of periocular adipose tissue through a weak tarso-orbital fascia (septum orbitale) occurring at any age (very common).[3, 4]

### Lid anatomy[5]

The lid is separated into four planes from superficial to deep, as follows: (1) Skin, (2) muscular (orbicularis oculi), (3) fibrous (septum orbitale), and (4) palpebral (tarsal) conjunctiva.

The septum orbitale is a fibro-elastic connective-tissue membrane, lying deep to the orbicularis oculi muscle but superficial to the periorbital fat and tarsal conjunctiva. It is attached all around to the orbital bony rim and to the curved tarsal plate edges. In the upper lid it blends in with the insertion of the fibers of the levator muscle, then to the anterior surface of the tarsus.

### Differential diagnosis

1. The first six causes of baggy eyelids, already listed, result in redundant skin which is wrinkled, folded, and baggy. Blepharochalasis is a good example for the upper lid, epiblepharon for the lower lid. This type occurs mostly in the aged (epiblepharon excepted) and does not change sizes from morning to night nor from day to day.

2. Cases produced by the seventh cause—excess fat or herniated periocular fat pushing the skin of the lid forward—may occur at any age and the resulting deformity may change in size from morning to night or from day to day. Backward pressure on the globe through the closed lids forces the adipose tissue forward causing an obvious deformity of the lids.

3. Epiblepharon is a rare congenital anomaly characterized by a horizontal fold of skin which covers the margin and lashes of the lower eyelid. When the condition is severe, it causes a permanent turning in of the lashes which scratch the globe.

4. Any retrobulbar tumor (lipoidosis[6]) may cause baggy lids; however, proptosis of the globe is also present.

5. Pouching of the eyelids may be present in hyperthyroidism, myxedema, chronic nephritis, Quick's edema, and so forth.

### Technique for repair

For baggy eyelids due to the first six causes already listed, any plastic surgery book[9] will give the technique for taking up the redundant skin and smoothing it out.

To repair baggy eyelids produced by excess or herniated fat, the following technique is used:

Several drops of pontocaine (one percent) are instilled at two minute intervals. A novocain-adrenalin-hyaluronidase solution is then administered subcutaneously and by peritarsal infiltration into the involved lid. Also, a small amount of novocain solution is injected into the periosteum of the infra-orbital margin.

A general anesthesia is used if needed.

*Skin incisions* are made at one of several locations:

1. Make the incision 1.0 to 1.5 mm. below and parallel to the margin of the lower lid[4] from inner canthus to outer canthus, then free the skin down to the lower orbital margin.

2. Make the skin incision 4.0 mm. below and parallel with the lower lid margin[8] and free the skin to the orbital margin.

3. Make the skin incision just above the lower orbital rim,[3] running from inner to outer canthus.

4. Make the skin incision at the upper edge of the adipose swelling,[11] marking it

clearly before making the injection for local anesthesia. Undermine the skin downward. Separate the muscular fascia below or away from the skin incision so that undesirable cicatricial contractions of the lid are not produced. When the muscular fascia is entered, the fat which immediately presents should be removed by blunt dissection, carefully without tractions so that none of the bright yellow periocular fat presents into the wound.[8] (I prefer this fourth method of making the incision.)

Some surgeons use 3-0 to 6-0 buried silk sutures to close the septum orbitale; others do not attempt to close the fascia.

After removal of the excess fat, excess skin is always present. Part of this is excised to get a tighter, more smooth, yet relaxed, skin closure. Closely set, fine, black-silk, interrupted sutures are used. Good apposition of the wound produces quicker healing, and the quicker the healing the less chance for scar formation.[10]

A slight pressure bandage is applied to the eyes for two or three days. The skin sutures are removed in three to four days, leaving sutures in longer may cause suture scars.

Removal of the fat pouch through the lower conjunctival fornix should not be attempted. This approach might interfere with the delicate attachment of the inferior rectus to the lower lid, thereby causing lid displacement.[11]

### Complications

1. Ectropion may result if too much skin is excised.
2. Keloid formation, especially in Negroes, is a danger.
3. Fat may herniate through the lips of the wound.[7]

*2007 Wilshire Boulevard (5).*

### References


1. Schmidt-Rimpler: Centrabl. f. prak. Augenh., **23**:297-299, 1899.
2. Kestenbaum, O.: Wien, med. Wchschr., **78**:228-229, 1928.
3. Bames, H. O.: J.A.M.A., **144**:692 (June) 1951.
4. Holden, H. M.: J.A.M.A., **144**:692 (June) 1951.
5. Whitnall, G. E.: Anatomy of Human Orbit. London, Oxford, 1932.
6. Handousa, A. B.: Brit. J. Ophth., **36**:20, 1952.
7. Am. Encyclopedia Ophth. v. 2, p. 1037.
8. Sakler, B. R.: Am. J. Ophth., **20**:936 (Sept.) 1937.
9. Hunt, H. L.: Plastic Surgery of Head, Face and Neck. Philadelphia, Lea, 1926 p. 196.
10. Bettman, L.: Ann. Surg., **88**:994, 1928.
11. Elschnig, A.: Klin. Monatsbl. f. Augenh., **88**:763-766, 1930.
12. Deschamps: Ann. d'ocul., **119**:383, 1899.


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## A PRISM FOR GONIOSCOPY

M. C. Colenbrander, M.D.
*Leyden, Holland*

About 10 years ago I used a common rectangular prism for the purpose of examining the angle of the anterior chamber, pressing it against the cornea, which was flattened. This method was not unsatisfactory.

The results were better when I used a prism with a concave lower surface, the cornea being no longer distorted.

I selected a radius of 8.5 mm. for the curve of the concavity; on placing the prism against the cornea the first contact is made in the center of the prism, and on exercising a little pressure the air may escape in all directions, no air bubbles being held. The application of this prism requires no manual

The prism is obtainable from Observator, Ltd., Westzeedijk 52, Rotterdam, Holland. Its price is about £7.

Fig. 1 (Colenbrander). The prism put on a stamp. Through the oblique side of the prism the face of the Queen of the Netherlands is three times visible, once in a direct way and twice reflected.

skill, and no water is spilled.

In an eye with a shallow chamber only the upper and the lower parts can be seen properly. Why is this?

A slitlamp deals with three pencils of light—namely, one from the slit toward the eye, and two from the eye toward the two object glasses of the microscope. The three pencils are arranged in a horizontal row. In a shallow chamber, this causes only the upper part and the lower part to be seen properly, since there is only room for the pencils in a horizontal row.

It may, however, be desirable to observe the lateral sides of the anterior chamber

Fig. 2 (Colenbrander). The prism seen from the same side as in Figure 1, showing several faces of the prism. At the bottom the hollow groundface is seen and at the rear the two vertical sides, also reflecting the groundface.

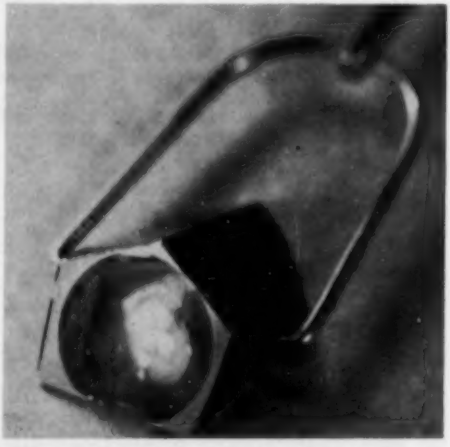

Fig. 3 (Colenbrander). The prism lying on its oblique side and seen from the underside. The rooflike back face and one triangular lateral face are seen in black.

accurately. It is only possible to do so by swinging the pencils by means of reflection, and this can be effected by replacing the back surface of the prism by two vertical surfaces fused to the roof.

I selected a top angle of 120 degrees, as this angle prevents double reflection, and so any possible confusion is precluded. With an angle of 120 degrees, one is, moreover, able to examine three parts of the chamber simultaneously, these parts being accurately distributed at angles of 120 degrees.

A further advantage is that the mean image is not of the reflected kind, so that right and left, or up and down, are not interchanged and cannot be confused.

A minor disadvantage is that the subject must turn his eyes in order to present the angle of his ocular chamber straight before the microscope. This drawback has been diminished by selecting a more acute vertical angle of the prism—namely 30 degrees instead of 45 degrees.

Moreover, the visual field of the reflecting surfaces is widened; they could be further broadened by slightly diverging the sides of the prism.

The figures show the prism in its present shape, all the faces of which have been altered from the original shape.

The various changes have resulted in the following improvements:

1. The application requires no manual skill.

2. The mean image is not reversed by reflection and orientation is easy.

3. One can see three sectors of the ocular chamber simultaneously.

4. A shallow chamber can be examined in all directions.

5. The prism may very well be utilized for goniotomy.

*Oude Vest 105.*

## OPHTHALMIC DIAGNOSTIC KIT

RICHARD J. CARBO, JR., M.D.
*Washington, D.C.*

A small diagnostic kit for consultation calls and emergency treatment contains the necessary instruments and medications. It can be made up inexpensively from items found around the office and home. It is always ready for immediate use and eliminates the need of carrying pocketsful of equipment, as well as the loss of time waiting for nurses to collect necessary instruments.

It consists of a half-size brief case, a leather insurance envelope, or a tie container, about five by 12 inches which has compartments on either side (fig. 1).

One side is used for the ophthalmoscope, necessary medications in five-cc., dropper bottles (Cortone bottles), one bottle of sterile applicators, and a large No. 18 or No. 20 needle with a bent end (for an eye spud). A pocket contains various ointments and a magnifying glass. Everything is held in place by elastic binding tape.

The other side of the kit holds a prescription pad, eyepads, and a narrow roll of scotch tape.

*1746 K Street, N.W. (6).*

Fig. 1 (Carbo). Ophthalmic diagnostic kit.

# SOCIETY PROCEEDINGS

Edited by DONALD J. LYLE, M.D.

## COLORADO OPHTHALMOLOGICAL SOCIETY

January 17, 1953

DR. FRITZ NELSON, *president*

### MALIGNANT EXOPHTHALMOS

DR. GEORGE ELLIS AND DR. JOHN C. LONG discussed metabolic exophthalmos in some detail. The Guyton technique for decompression of the orbit was described and illustrated with photographs. The results of nine temporal orbital decompressions in five patients were presented and the conclusion was that this procedure is a highly useful and relatively safe treatment for metabolic exophthalmos.

### MYOGENIC FAMILIAL PTOSIS

DR. DANIEL FRANKLIN presented Mrs. F. T., aged 54 years, who complained of gradual drooping of the lids of both eyes but worse on the left. This condition, which had started when she was 35 years of age, now interfered with vision, especially in the morning. Her grandfather, father, and at least five siblings were similarly afflicted. In old age, the eyes were mere slits. Operations on some members of the family had brought only temporary relief. There was no history of weakness or paralysis of any other muscles.

The patient's general health was good. General physical examination, laboratory tests, and neurologic examination with repeated Neostigmine tests were negative. There was no evidence of myasthenia gravis.

The eye examination was essentially negative except for the ptosis. The patient was given crutch glasses which relieved the ptosis.

*Discussion.* Opinion was expressed that the condition was due to myogenic involvement of the levators or the rostral nucleus of the third nerve. It was considered to be familial.

### COMPLICATIONS OF BRUCELLOSIS

DR. MORRIS KAPLAN presented Miss S. E., aged 26 years, who had complained of diminished vision in the left eye for four years. After a recent sudden decrease in visual acuity, a careful search for foci of infection revealed that she had brucellosis. It was learned that she had worked with brucellosis as a laboratory technician.

Although energetic treatment was given for the brucellosis, the condition remained active and the patient was given brucella vaccine at monthly intervals. She continued to complain of recurring scintillating scotomas in each eye, although they occurred less frequently. Uncorrected vision was: R.E., 20/40; L.E., 10/400; corrected: R.E., 20/15; L.E., 20/400.

Fundus examination revealed a large, sharply punched-out ulcer involving the entire macula of the left eye. The dull-gray center of the ulcer (as if in direct view of the sclera) was surrounded by a ring of pigment. In the periphery of each eye, there were several areas of healed choroiditis which resembled in appearance the macula of the left eye. The macula of the right eye was normal.

Although the patient still shows a positive brucellosis test, her condition is slowly improving and, as a result, the flareups of choroiditis are becoming less frequent.

### TRANSPLANTATION FOR CONICAL CORNEA

DR. MORRIS KAPLAN presented Mrs. F. R., aged 34 years, who for years had been wearing contact lenses for conical cornea which continued to progress. For six months she had not been able to wear the contact lenses and requested surgery. Vision with the lenses was 20/40, O.U.

On December 13, 1952, a six-mm. corneal transplantation was done. As soon as the bandages were removed, cortisone drops were started. The patient was shown at this meeting to demonstrate the effect of the cortisone. Ordinarily, four to six weeks after operation there is a 0.5-mm. ridge around the transplant. Its absence in this case was believed to be due entirely to cortisone.

### Marcus Gunn Syndrome

Dr. John C. Long presented a case of the Marcus Gunn syndrome (jaw-winking reflex) of the right eye in an 11-year-old boy. In addition to marked jaw winking, there was complete paralysis of the superior rectus muscle with downward displacement. The paralysis of the superior rectus was partially relieved by recession of the inferior rectus and advancement and resection of the superior rectus and by a Hummelsheim operation which utilized portions of the medial and lateral recti.

Daniel Franklin,
*Secretary.*

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## YALE UNIVERSITY CLINICAL CONFERENCE

January 30, 1953

Dr. R. M. Fasanella, *presiding*

*Round Table Discussion*

### Surgical problems and their management

### Re-operations in glaucoma

Dr. Edmund B. Spaeth, Philadelphia, the guest speaker, replied to the following questions:

1. *After two goniotomies failed to reduce the pressure in a hydrophthalmos, what would you do next?*

Dr. Spaeth: Another goniotomy and goniopuncture. Hydrophthalmos before Barkan did not respond to filtering operations, and very few responded to cyclodialysis. I would also do a fourth goniotomy if necessary. It can be done with or without the use of a contact lens or air injection. The eye should be rotated for each goniotomy so that a different area can be attacked from the temporal approach each time. Goniopuncture should not be done unless you can see the angle well.

2. *How long will you wait for a chamber to form after a glaucoma operation? What would you do?*

Dr. Spaeth: Every case is different. With a trephination, one would wait longer than with an iridencleisis. With cyclodialysis, the chamber should reform quickly. It may depend on the presence of a so-called choroidal detachment. If this is the case, do nothing; or in some cases, possibly transscleral diathermy can be done to drain the site of a subchoroidal detachment. If no choroidal detachment is present, inject air immediately if, cyclodialysis has been done, to avoid danger of posterior synechia formation. In iridencleisis, it is less significant. If the chamber forms too soon, eyeball massage can be done. In trephinations, look for a hole in the flap with fluorescein. For anterior synechias, inject air as soon as you are concerned; push cycloplegia.

3. *How would you manage severe persistent hyphema after a filtering operation?*

Dr. Spaeth: Blood staining of the cornea is the chief problem, if the hyphema is present under increased tension. If no sign of improvement, do a puncture and counterpuncture at the 9- and 3-o'clock positions and irrigate through. Break up the clot with Kalt forceps if necessary. Leave the operative site alone.

4. *How soon is re-operation indicated and what type of procedure offers the best prognosis when there is a rise in ocular tension: (a) Soon after the original operation? (b) Several weeks after the original operation?*

Dr. Spaeth: I would divide this into four classifications:

a. Immediate failure.

b. Several weeks after operation.

c. Years after original surgery.

d. After cataract surgery subsequent to a glaucoma operation.

Immediate failure is usually due to a complication of the surgery, intraocular hemorrhage, hydrops of the ciliary body, and so forth. Treatment is really the handling of the complication.

When the rise occurs several weeks afterward, re-evaluate the entire case as if it were a new one. In general, do not repeat an operation which was unsuccessful. If several years afterward, manage entirely as you would a new case.

After cataract extraction following previous glaucoma surgery, in general the rise responds to cyclodialysis. You cannot do a filtering operation very well, as you may get vitreous in the filtration track. Cyclodiathermy may be indicated, but I am not too enthusiastic about this.

*Dr. Dewey Katz:* Would you expand on the loss of a remaining small field following operation in advanced glaucoma?

DR. SPAETH: I think the operation has to be done with the following points in mind: The anterior chamber must be emptied very slowly, to minimize the effect of the change in tension on the choroidal capillaries in the macula. Proper dehydration preoperatively, retrobulbar anesthesia, scratch incision should be done for the same reason. I do not like cyclodiathermy here.

In a compensated glaucoma, with tension below 40 mm. Hg and miotics unsuccessful, one can do cyclodialysis. When an inflammatory phase precedes the glaucoma, cyclodialysis is contraindicated. Iridencleisis has the same general indications as trephination. If you expect to do lens surgery later, iridencleisis is better.

*Question from floor:* Would you discuss the occurrence of sympathetic ophthalmia following iridencleisis?

DR. SPAETH: It is perhaps a little more common than after trephination or cataract extraction because it is a little more inflammatory. I had one case, and have seen three or four in consultation. Now, with cortisone routinely before and after all planned glaucoma operations, it should not occur.

LENS TRAUMATISMS

1. *How would you proceed with a glaucoma operation after the lens capsule is accidentally perforated during the course of surgery?*

2. *After the lens capsule perforation is recognized during the postoperative convalescence, when would you proceed with the extraction?*

DR. SPAETH: In general, the sooner the operation, the better. When instrument damage has occurred, it is seen three or four days later. The longer the delay, the more likely an intractable uveitis will develop. Minimal rents in lens capsule can occur with release in tension and anterior displacement of the lens, not due to the instrument. Extracapsular extraction should be done here. If lens is damaged at operation, wait three to four days before proceeding with the extraction.

*Dr. Dewey Katz:* Could suction be used?

DR. SPAETH: I do not like to use an erisophake (except the small Dimitry) on a hypermature lens.

3. *What is your method of choice for removal of a mature cataract which has developed after a filtering operation for glaucoma?*

4. *What is your experience or feeling on a temporal incision in extracting a mature cataract which has developed following a filtering operation for glaucoma?*

DR. SPAETH: In general, excepting mechanical trauma to the lens, I do not believe a fistulizing operation causes cataract. A Lagrange operation may hasten maturity, but not iridencleisis or trephination.

I now prefer a temporal incision with a keratome, extending the incision to the margin of the bleb. I use postplaced sutures after the incision and no flap. Complete iridectomy may be added but, if the pupil is open, this is not necessary.

FACTORS IN FAILURE OF MUSCLE SURGERY

1. *How much vertical deviation justifies surgery?*

2. *What types of vertical surgery do you do and for what indications?*

DR. SPAETH: There are a large number of vertical deviations if you look for them. Any vertical deviation which breaks single binocular vision in any direction justifies surgery. If the vertical deviation is greater than the horizontal, do the vertical first. Some vertical deviations are consequent to the horizontal deviation. In choosing the type of operation, do not disturb binocular function. A recession of the superior oblique is impossible; a recession of the superior rectus is unsound.

*Dr. Schwartz:* How often do you operate on three or four muscles at one sitting?

DR. SPAETH: If you know what you want to do, you may do two or three muscles. But I do not hesitate to plan two or three operations.

*Dr. Katz:* What is the earliest age for operation in concomitant strabismus?

DR. SPAETH: About two years old is the earliest rational age.

3. *Do you believe in early operation in strabismus? How early?*

DR. SPAETH: As early as a full diagnosis can be made and the secondary characteristics, suppression, and so forth, corrected. One must know the surgical component of an accommodative strabismus. Alternating strabismus can be operated early.

4. *What part do orthoptics play in your postoperative treatment?*

DR. SPAETH: Orthoptics, pre-operatively, is diagnostic procedure only. I am not referring to suppression amblyopia and anomalous correspondence. The latter is corrected in many cases by breakup of the suppression amblyopia. Postoperative orthoptics is important. However, in accommodative strabismus, no postoperative orthoptic problem is present. Alternating strabismus is not a problem for orthoptics. Monocular esotropia of the neurogenic type does have postoperative problems in re-establishing and maintaining correspondence, keeping suppression broken down and building up binocular vision.

William Glass,
*Recording Secretary.*

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## CHICAGO OPHTHALMOLOGICAL SOCIETY

December 15, 1952

DR. WILLIAM F. HUGHES, JR., *president*

CLINICAL MEETING

Presented by the Departments of Ophthalmology of Hines Veterans Administration Hospital and Presbyterian Hospital.

TRAUMATIC CATARACT AND IRIDOCYCLITIS

DR. MARVIN D. HENRY presented W. J. B., a 33-year-old white man, who entered Hines Hospital on April 9, 1952, complaining of pain, tearing, and burning of the left eye of two days' duration. He had had seven previous attacks of iritis since 1935, the last being in the summer of 1951. The first attack came on when a piece of stone struck the left eye. He served two years in the Army on limited duty and, upon discharge, vision was reduced to large objects seen only at near.

The right eye was normal; vision 20/20. Vision in the left eye was reduced to hand movements at two feet with good light projection; the pupil was miotic, with 20 degrees of exotropia.

Slitlamp examination revealed multiple fine pigmented keratic precipitates on the corneal endothelium, with a healed penetrating scar one mm. from the limbus at the 6:30-o'clock position. The anterior chamber had a +1 beam with a moderate number of cells in active motion.

The iris had a greenish cast, in contrast to the blue iris of the right eye, and showed moderate atrophy and iridodonesis. The pupil could not be dilated. An opaque white

irregularly flat surface was seen behind the iris.

The left fundus was not visible. The right fundus showed an area of pigmentation at the 5:30-o'clock periphery, apparently an old inactive chorioretinitis.

X-ray films revealed a tiny metallic foreign body in the left orbit, localized at the 5-o'clock position, two mm. behind the limbus.

On April 11, 1952, under local anesthesia, a limbus-based flap was prepared, and a complete iridectomy was made superiorly. With the Lancaster magnet, a one-mm. metallic foreign body was drawn from beneath the iris and with it came the capsular remnants of the lens. There was no loss of vitreous.

The eye healed uneventfully and on May 23, 1952, vision was corrected to 20/25 with a +11.25D. sph. ⊂ +0.75D. cyl. ax. 40° and to five-point type with +2.5D. add. Fundus examination showed the anterior one-half of the vitreous to be degenerated and fluid, with multiple opacities.

### Malignant melanoma of eyelid

Dr. S. S. Philbrook presented S. S., a 31-year-old white man, who entered Hines Hospital on June 23, 1952, stating that he had had a small growth of the right lower eyelid for 10 years. The month prior to admission he had three episodes of conjunctivitis of the right eye.

Visual acuity was 20/20, each eye. On the margin of the right lower lid was an elevated light brown nodule with a slightly darker center, about 5.0 mm. by 3.0 mm. in size and 2.0 mm. in elevation. There was slight redness of the lower palpebral conjunctiva. The eye was otherwise negative. There was no pre- or postauricular lymphadenopathy.

The tumor was excised on June 25, 1952, by block resection of the entire thickness of the lid including the conjunctiva. A sliding closure was made.

Pathologic examination revealed the tumor to be a malignant melanoma and, on July 17th, under general anesthesia, excision of the lower right eyelid, block resection of the cheek, and radical neck dissection was performed. Examination of the tissue excised revealed no evidence of malignancy.

On October 21, 1952, the scars were well healed, with absence of the entire lower right eyelid, and a defect in the right side of the neck. There was atrophy of the right trapezius muscle. No clinical evidence of malignancy was found. Plastic repair of the right eyelid will be carried out at a later date.

### Localized choroiditis simulating neoplasm

Dr. Murphy said that G. P., a 46-year-old white woman, was first seen in the eye clinic at Presbyterian Hospital on March 20, 1952, with a complaint of headache and blurring of vision for a period of one year. In January, 1952, a small pedunculated mass at the mucocutaneous junction of the right anterior nares had been removed, the pathologic report on which was squamous-cell carcinoma.

Examination disclosed a fundus lesion in the left eye, located below the disc and underlying the inferior nasal retinal vessels. The lesion was a sharply demarcated, slate-gray area of depigmentation surrounded by a zone of increased pigmentation about two disc diopters in size.

Complete physical examination, including roentgen studies of the entire body and radioactive $P^{32}$ study of the eyes, was considered negative, and all laboratory tests were within normal limits.

The patient has been followed in the eye clinic since April, 1952, and the original lesion has not changed appreciably in size, although it has assumed a more yellowish color and pigmentation has increased slightly.

Originally the possibility of a metastatic neoplasm was considered but, in view of the negative findings, the conclusion was reached that this is a localized choroiditis of undetermined etiology.

EXOPHTHALMOS AND THYROID DYSFUNCTION

DR. JOHN W. HENDERSON, Section of Ophthalmology, Mayo Clinic, Rochester, Minnesota, presented a paper on "Exophthalmos associated with thyroid dysfunction." An abstract follows:

Some of the current theories concerning the mechanism of the exophthalmos associated with thyroid dysfunction were reviewed and its relationship to various metabolic phases of the thyroid gland were noted. Present research would point to the pituitary gland as having a major role in the production of the exophthalmos.

The pathology of the changes in the orbit were discussed from five main standpoints. These were: (1) The fluid balance of the orbit, (2) the changes in fat metabolism, (3) the alteration of muscle tissue, (4) the response of the fixed tissue cells and circulating leukocytes, and (5) the alterations occurring in the connective tissue.

The speaker was mainly concerned with the clinical behavior of the orbital disorder. It was emphasized that accurate measurements and records must be made of the appearance and changes of the eyes and orbit so that, from time to time, it would be possible to record accurately changes in the disorder.

Nine clinical features of this disease were emphasized and the methods for recording and grading them were discussed. These features were: (1) The position or displacement of the globe, (2) the Hertel measurements, (3) the degree of ophthalmoplegia, (4) the presence or absence of chemosis, (5) the degree of congestion and engorgement of the blood vessels, (6) soft tissue edema and swelling of the eyelids, (7) visual acuity, (8) the status of the optic nerve, and (9) examination of the fundus of the eye.

The significance of these measurements in relationship to the clinical course of the disorder was discussed. It was the speaker's opinion that two different types of ophthalmoplegia might occur during the course of the disease. It was also pointed out that many of the complications that occur in the cornea in the progressive cases are due to an interference with metabolism of the cornea and its nutrition rather than simply to exposure. The indications for blepharorrhaphy were mentioned. The present concepts concerning the treatment by means of deep X-ray therapy and/or orbital decompression were briefly discussed.

In conclusion, it was felt that a more detailed study of the orbital manifestations of this disorder was necessary so as to be able to determine or predict more accurately their clinical course.

*Discussion.* In reply to a question as to whether surgeons are advised about performing thyroidectomy, Dr. Henderson said that it was impossible to say what effect thyroid surgery might have.

As to reduction in sensitivity of the cornea, no measurements have demonstrated a significant change until the disorder reaches an advanced stage. When the cornea begins to become necrotic, there seems to be hyposensitivity.

With regard to treatment, the internists treat most patients by Lugol's solution and desiccated thyroid, particularly if the basal metabolic rate is below zero. He could not enlarge on the rationale of therapy with Lugol's solution, and was not sure that the internists know what its exact effect on exophthalmos might be.

Most general surgeons feel that subtotal thyroidectomy is the best treatment for thyrotoxicosis. Although it is true that, since the advent of subtotal thyroidectomy, there has been an increase in the incidence of exophthalmos following relief of thyrotoxicosis, it must be remembered that formerly many patients lost their eyes from thyrotoxicosis alone. It is felt that subtotal thyroidectomy is justified because it will control one feature of the disorder, thyrotoxicosis.

Richard C. Gamble,
*Recording Secretary.*

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## GERMAN OPHTHALMOLOGY

One hundred years ago Friedrich Wilhelm Ernst Albrecht von Graefe established single-handedly the *Archiv für Ophthalmologie* and launched with it the golden age of German ophthalmology. His father, Carl Ferdinand von Graefe, had participated previously in founding the short-lived *Journal der Chirurgie und Augenheilkunde* (1820-40, 1843-50). The *Archiv für Ophthalmologie* is the second oldest ophthalmic journal in continuous publication, the first being the *Annales d'Oculistique,* founded by Cunir in 1838. The first volume of the *Archiv für Ophthalmologie* was dedicated to Graefe's honored teacher, Friedrich Jaeger, and contained 481 pages of which 384 pages were contributed by Graefe himself. The illustrations, all at the end of the volume, included beautiful color plates from paintings by Liebreich of fundus pictures of ocular cysticercus and glaucomatous excavation. In

this issue Wyngaarden, a student of Donders, presented the first clinical use of pinhole spectacles, discussing six cases of corneal opacity with marked visual improvement through the pinhole—a device that his master had just introduced into ophthalmology.

With the second volume of the *Archiv für Ophthalmologie,* Arlt and Donders were added to the editorial staff, but Graefe maintained editorial direction through 16 volumes till his death in 1870. The successive editors-in-chief have been Leber (1870-1900), Wagenmann (1900-1945), Wessely (1945-1953) and Engelking (1953 to date). The distinguished staff of associate editors included these and Snellen, Sattler, Fuchs, Hertel, Marchesani, Löhlein and H. K. Müller. The *Archiv für Ophthalmologie* contains most of Graefe's discoveries and is still the leading German organ of ophthalmology.

In the first volume Graefe discussed disorders of the obliques, keratoconus, diphtheritic conjunctivitis, and the arterial pulsation in glaucoma. In the third volume he presented the iridectomy operation for glaucoma, which he had initiated in 1856, with the idea of thus decreasing the amount of aqueous secreted by the iris; also in this volume were his effective operations for concomitant and paralytic squint.

In 1859 (volume 5), he depicted the fundus pictures of hypertensive retinopathy and embolism of the central retinal artery. In 1860 (volume 7), he described choked disc and noted its association with brain tumor. In 1861, he noted the lid-lag in exophthalmic goiter. His articles on the cataract operation (1865-68) made his technique long popular. In 1866, he further discussed ocular paralyses and made his notable observations on sympathetic ophthalmia. In 1869 he reported the secondary glaucoma induced by rapid swelling of the crystalline lens.

The *Archiv für Ophthalmologie* has recurrent 10- and 20-volume indices, and in 1905, a 50-volume index was prepared! As is characteristic of many German publications, the issues appear at indefinite dates. The assembling of four to eight numbers makes up a volume of 500 to 600 pages. Until 1888, there was one volume per year but since then the volumes have come about twice as often, the current issues forming volume 155.

The acknowledged hegemony of Germany in ophthalmology, medicine, and science gradually gave way before the competition from without and the deteriorating forces from within. In 1905, all the Nobel prizes were awarded to Germans but, in 1946, United States of America took all the honors. Before World War I, German was the predominant language of science; now English leads with half of the world's scientific articles and French is in second place. At the forthcoming International Congress of Ophthalmology the only three official languages are English, French, and Spanish.

As the first World War loomed—about 1912—medical education in Germany was cheapened. Overlarge classes were taught mainly by didactic lectures with inadequate practical training in laboratory and clinic. World War II determined much further deterioration with state control of the selection and activities of both the students and the teaching staff. The Nazi dictatorship demanded of everyone ideologic conformity and active participation in its objectives. The bombast of newspaper, forum, and radio echoed in the medical journals. The professional ranks were rid of all representatives of Jewish lineage. Fortunately many famed ophthalmologists escaped to foreign havens.

Happily the gracious von Graefe lived in a saner Germany; among his favored students were Liebreich, Hirschberg, Javal, Laqueur, and Jacobson, teacher of von Hippel—all of Jewish blood. Wagenmann, however, applauded Hitler (*Archiv für Ophthalmologie,* 1933) and, during the Nazi reign, docily accepted orders as to who may publish what.

Nature healing, one of the many fantasies

of the ruling clique, had its day. Articles appeared advocating scrubbing the skin while bathing in cold water as a remedy for uveitis, glaucoma, and other ocular maladies. Hereditary eye diseases were discussed extensively with the intimation that those afflicted were a social menace. Bückler's investigation of the hereditary dystrophies of the cornea in 1938 was undertaken at the behest of the Nazi government as a detail of the state program of sterilization of the unfit.

The *Zeitschrift für Ophthalmologische Optik* and the *Zeitschrift für Augenheilkunde* ceased in 1933 when their publisher fled to Switzerland. In its new habitat, the latter journal metamorphosed into the fine international publication, *Ophthalmologica*. The *Archiv für Augenheilkunde*, whose staff were persona non grata, lost its independent existence in 1938 and merged with the *Archiv für Ophthalmologie*. Wessely, its directing editor, was of one-quarter Jewish heritage, while the associate editors, Hertel and Krückmann, were known as anti-Nazi. Economy was the official explanation (*Archiv für Ophthalmologie* vol. 139, 1939).

Medical participation in the crimes against humanity started with acceptance of the euthanasia movement. The first sequence was the extermination of 275,000 Germans classified as physically or socially unfit. The destructive principle kept spreading; in a Polish area all inhabitants showing positive X-ray findings of tuberculosis were slaughtered.

Professor Clauberg, at an open medical meeting, reported a method of sterilizing 1,000 women daily. In Holland, the physicians sensed the dangerous implications of the "eugenic" program and unanimously turned in their licenses rather than give the slightest co-operation. Although 30 percent of the Netherlands medical faculty was liquidated, their honor and courage remained steadfast and not a single enthanasia or nontherapeutic sterilization received the sanction of their complicity. Our own numerous lay organizations such as the American Foundation of the Blind, the American Cancer Society, the National Multiple Sclerosis Society, Alcoholics Anonymous, and so forth, which are dedicated to the guidance of the afflicted and the support of medical research, could have had no existence under the Hitler regime.

After the collapse of the Third Reich, the old Wessely, who numbered among his honors membership in our Interstate Postgraduate Medical Association, became directing editor of the *Archiv für Ophthalmologie* and continued until his death, February 25, 1953, at the age of 79 years. An auspicious beginning of this second century of Graefe's *Archiv* is signalled by the appearance of two new vigorous and democratic personalities on the editorial staff—Engelking of Heidelberg at the helm, and associate editor J. K. Müller of Bonn. Forthwith the bibliographic standards improved with complete notation required of author, title, journal, volume, page, and year. Prof. Ernst Engelking, who worthily succeeds to the mantle of von Graefe, was born May 5, 1886. His education in ophthalmology was under the stimulating influence of Axenfeld and von Kries at Freiburg. His major publications have been on the color and light perceptions, but he has also contributed significant articles on xanthomatosis bulbi, metastatic myositis of the extraocular muscles, eye defects from radiation in pregnancy, retinal detachment, keratitis sicca, and military ophthalmology. A lustrous editorial career is anticipated—"The best of prophets of the future is the past."

James E. Lebensohn.

## XVII INTERNATIONAL CONGRESS OF OPHTHALMOLOGY

Montreal, Canada—September 10 and 11, 1954

New York City—September 13 through 17, 1954

Subjects for discussion: *Glaucoma* and *Uveitis*

## CORRESPONDENCE

### GUMMA OF ORBIT

Editor,

American Journal of Ophthalmology:

When reading the August, 1953, issue of the JOURNAL, I came across the editorial relating to the Golden Jubilee of the Egyptian Ophthalmological Society. When making his observations, Dr. Thygeson refers to three cases of gumma of the orbit by Prof. M. A. H. Attia and from this it would seem that Dr. Thygeson was not present when I personally spoke and drew attention to the fact that Professor Attia should have made reference to my paper on this subject "Syphilitic gumma of the orbit" which was published in the *Bulletin of the Egyptian Ophthalmological Society*, **32**:50, 1939, in which I dealt with three cases of syphilitic gumma and syphilitic periostitis of the bony orbit.

Furthermore, regarding the report by Dr. I. A. Mohamed and Dr. G. Badir on epidemics of virogenic acute keratoconjunctivitis, I made mention of this epidemic, the first of its kind in the history of Egyptian ophthalmic hospitals, in Bulletin No. 16 of 1923 and in more recent Egyptian ophthalmic literature. This was an epidemic outbreak of diphtheric conjunctivitis.

I hope you will forbear with me for mentioning these points which, I think you will agree, are of some significance in the over-all background to the subject matter.

(Signed) Abdel Messih Girgis, M.D.
Cairo, Egypt.

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## BOOK REVIEWS

HANDBOOK FOR THE BLIND. By Juliet Bindt. New York, The Macmillan Company, 1952. 224 pages. Price: $3.50. (Recorded on Talking Book Records—available to the blind from the Library of Congress.)

No matter how disheartened the patient may be when he learns that he is going to be blind, the ophthalmologist who has done his best still has enormous influence in the doctor-patient relationship. There is a growing interest among people in the field of work for the blind in better ways of helping doctors make the most of this remaining influence. It seems important that the ophthalmologist be liberated as soon as possible from work with the newly blinded. His sights must always be set on saving eyes, and he cannot be eternally burdened with giving psychotherapy to patients when this is not possible. However, he is in a position to steer the patient toward rehabilitation measures, and it is extremely important that the doctor have all the help he needs in doing this.

Successful blind people, when asked what experience has been most helpful in their rehabilitation, frequently mention a person rather than an event or mechanical aid. Quite often it is another person who has learned to manage the handicap of blindness. At the right time, for the right patient, a book by a blind person can be helpful. There have been a number of such books, of which Pierre Villey's *World of the Blind*, translated from the French, remains the classic. *The World at My Fingertips*,* by Karsten Ohnstad; *Whereas I was Blind*,* by Sir Ian Fraser; *My Eyes Have a Cold Nose*,* by Hector Chevigny; and *The Blind in School and Society*, by Thomas Cutsforth all project personalities which may spark the apathetic and paralyzed feelings of the person who has recently learned he must live without sight.

It is such a function chiefly that Mrs. Bindt's *Handbook for the Blind* might serve best. It carries a personality which is unquestionably full of vitality. The author has given a great deal of attention to the problems of blind people. She goes into everyday difficulties specifically, taking pains to enumerate a large number of items of

* Recorded on Talking Book Records—available to the blind from the Library of Congress.

method which can be of great assistance to the blind. These are especially helpful in the area of table etiquette—a problem which continues to be one of the greatest stumbling blocks of blind people in achieving social integration. (Too many blind people continue to order sandwiches in resturants to avoid the embarrassment of using tableware long after they have learned to go about on their own with the aid of cane or dog.)

There are, however, certain flaws in Mrs. Bindt's book as a handbook, which have already been noted in the literature. For example, *The New Outlook for the Blind* (May, 1952) contains an extensive review which points out that Mrs. Bindt has a rather limited concept of the possibilities of both the cane and the dog. For this reason, it seems important that doctors recommending the volume to the newly blinded person, or his relatives, make sure that other viewpoints are also represented. Indeed, it will be helpful to the ophthalmologist only as it is taken in conjunction with other similar literature, 4,200 items of which are listed in the standard bibliography, *Books About the Blind*, by Helga Lende, published by the American Foundation for the Blind.

In aids to the blind, it is time to make a distinction among what is eleemosynary, what is amateur, and what might be called *typhlologic*. The third of these terms, though little used, and not in every dictionary, is defined in Webster and the Oxford Dictionary as "the science that deals with blindness." This might well describe the thinking processes of Louis Braille, Howe, Anagnos, and Sir Francis Campbell. By contrast, Mrs. Bindt's book is wholesome, cheerful, and winning, but it is not *typhlology* in the same sense.

In recommending any or all of the books just listed, the ophthalmologist should know something about the book, as well as the patient. The best of the books can create havoc if they are offered to the personality with which they are ill matched. The born doubter would not be happy, for example, with Mrs. Bindt. To Hector Chevigny he might respond very well. *Bibliotherapy* should be most carefully prescribed for the newly blinded. (For a few, it should not be forgotten that *Paradise Lost* and *Paradise Regained*, by a man who lost his sight, are available on the Talking Book.)

It should be borne in mind, moreover, that there are certain hazards in having a newly blinded person listen prematurely to Talking Book records of books about blindness. The Talking Book mechanism is unfamiliar to the newly blinded, requires close attention, may easily symbolize blindness, and a negative reaction to it can develop because the entire experience is overbearing. The patient may turn off the record for no reason he will explain—perhaps for no reason he *can* explain. And sometimes he can never be persuaded to use it again. There is an extra danger of this if the text deals with blindness itself. The companionship of a wise and temperate flesh-and-blood reader would at least avert the fixing of a prejudice against the Talking Book as a mechanism, and would also make possible observation of the point at which the text produced a negative reaction, opening the way to resolution of whatever inner conflict has developed.

It cannot be overstressed that, in looking back on their turning points, blind persons stress the human element. No one in the entire human race is quite so important as the ophthalmologist at the time of a discouraging prognosis. When the doctor and the patient together must reject the eyes, it is all-important that the patient feel from the doctor a warm, basic acceptance of himself as a person with all possible respect for remaining capacities and interests. There is no substitute for this. It cannot be expected that an ophthalmologist read handbooks on blindness to the newly blinded, but it is of great assistance when he can find a member of the patient's family, a social worker, or someone in the field of rehabilitation who has enough common sense and kindness to explore the patient's new situation with him on a constructive basis.

C. Warren Bledsoe.

INTRODUCTION TO OPHTHALMOLOGY. By Prof. Dr. P. A. Jaensch. Stuttgart, Georg Thieme Verlag, 1953. 244 pages, 197 illustrations, some in color. Price: DM 22.

The first edition of *Introduction to Ophthalmology*, published in 1947, was written to serve as an ophthalmologic text for the German medical student. Well-known German textbooks on the subject were unavailable at that time. Even a casual glance through this small book indicates that the present second edition is well justified. It may seem impossible to condense the entire field of ophthalmology ("entire" being used here in the broadest sense of the word) into less than 250 pages; yet the author has been surprisingly successful in his endeavor. The very fluid style should make the book comparatively easy reading.

The sections on anatomy, physiology, and physiologic optics (the refractive power of the entire eye is 58.64 diopters and not 63, as stated!) are models of a lucid presentation of material that is rather difficult for the beginner. Embryology and developmental anomalies, covered on little more than one page, contain everything the student ought to know. The external diseases, of greater importance to the general practitioner than other phases of our specialty, are treated in great detail.

Jaensch discusses *two* forms of epidemic keratoconjunctivitis—in addition to the one known in this country, a different type was observed in Germany during the years 1952-1953. This second form is characterized by large egg-shaped follicles and pseudomembranes. The typical corneal changes appear between the seventh and 20th day. Though iridocyclitis is well covered, emphasis should have been placed on the two types, namely the serous and granulomatous forms. Since the book is intended for the general practitioner, greater recognition of the principal difference between these two forms would make it easier for him to search for the underlying systemic condition of patients referred to him.

Schreck's "micro-organismus sympathicus" is presented as an accomplished fact, whereas the theory that sympathetic ophthalmia is due to sensitivity to the uveal pigment is dismissed as being of only historic interest.

Various forms of visual field defects are well presented. A slight oversimplification of the factors involved in tract lesions is permissible in a text of this sort. The chapter on glaucoma is another example of how a complex problem can be treated in a superb fashion in a minimum of space. The importance of the role of the vitreous in the genesis of the disease is overemphasized; the author is obviously a disciple of Thiel. As such, Jaensch may have felt obliged to include the view of his teacher. There is doubtful value in presenting a highly controversial topic to the uncritical mind as a generally accepted fact.

Therapy is only outlined. It is stressed in the preface that the general practitioner soon will learn his limitations in this field. It is somewhat surprising to find obsolete treatments, such as subconjunctival injections of saline and instillation of Dionin recommended for a host of conditions, while the steroids are hardly mentioned. It is not quite clear whether scleral resection and lens extraction are actually designated as treatment for myopia, or whether they are only listed as oddities of an era long past.

This reviewer sees a shortcoming in the omission of certain clinical pictures, highly interesting to the general practitioner, instead of others that would appeal only to the ophthalmologist. For example, retrolental fibroplasia is mentioned only by name in the differential diagnosis of retinoblastoma, whereas the various forms of congenital cataract are discussed at great length.

The print, the illustrations, and the overall appearance of the book are unsurpassed. My few critical remarks should in no way detract from the tremendous value this excellent textbook has for the medical student.

Stefan Van Wien.

# ABSTRACT DEPARTMENT

EDITED BY DR. F. HERBERT HAESSLER

Abstracts are classified under the divisions listed below. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

## CLASSIFICATION

1. Anatomy, embryology, and comparative ophthalmology
2. General pathology, bacteriology, immunology
3. Vegetative physiology, biochemistry, pharmacology, toxicology
4. Physiologic optics, refraction, color vision
5. Diagnosis and therapy
6. Ocular motility
7. Conjunctiva, cornea, sclera
8. Uvea, sympathetic disease, aqueous
9. Glaucoma and ocular tension
10. Crystalline lens
11. Retina and vitreous
12. Optic nerve and chiasm
13. Neuro-ophthalmology
14. Eyeball, orbit, sinuses
15. Eyelids, lacrimal apparatus
16. Tumors
17. Injuries
18. Systemic disease and parasites
19. Congenital deformities, heredity
20. Hygiene, sociology, education, and history

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## 1

### ANATOMY, EMBRYOLOGY, AND COMPARATIVE OPHTHALMOLOGY

Appelmans, M., and Blockeel, J. **Examination of the vitreous with the electron microscope.** Ophthalmologica **124**:296-302, Nov., 1952.

This preliminary report on the structure of the vitreous as revealed by the electron microscope stresses the intricacies of the new method and the marked dependence of the pictures obtained upon the way in which the vitreous is handled. After most forms of fixation a fibrillar organization becomes apparent, with innumerable crystal-like bodies attached to and fitted within the fibrils. (5 figures, 13 references) Peter C. Kronfeld.

Binder, Rudolf. **The mucinous cells of the bulbar conjunctiva of Macacus rhesus.** Arch. f. Ophth. **153**:477-483, 1953.

The cells are described in detail. They probably originate from the basal layer of the epithelium. Cell divisions were not observed. Ernst Schmerl.

Garzino, A. **Study of fresh zonular fibers by the phase contrast microscope.** Rassegna ital. d'ottal. **22**:3-25 Jan.-Feb., 1953.

The writer shows that the zonular fibers do not originate directly from the cells of the retinal epithelium but take their insertion from a net of fibers which adheres to these cells. Such a network can be identified with the network of Müller, which is a prolongation of the lamina of Bruch, or lamina vitrea of the choroid. When the fibers arrive at the crystalline lens, they unravel to constitute the zonular lamella which is clearly differentiated from the lens substance. Some of the fibers assume a circular arrangement. (35 figures) Eugene M. Blake.

Kinugasa, H. **Electron-microscopic study of retinal pigment.** Acta Soc. Ophth. Japan **57**:436-438, July, 1953.

The author re-examined Sebruyns' report (Am. J. Ophth. 34:989, 1951). He employed the ultra-section method as well as the method used by Sebruyns. He could not demonstrate any filamentous process, as described by Sebruyns, at one of the extremities of the pigment granule. (4 figures, 3 references) Yukihiko Mitsui.

Parry, H. B. **Degenerations of the dog retina. 1. Structure and development of the retina of the normal dog.** Brit. J. Ophth. **37**:385-404, July, 1953.

Detailed studies were made of the structure and development of retinas of normal dogs of several breeds. The dogs were bred in the laboratory and were studied frequently clinically and at autopsy. The pupillary reactions, visual acuity and funduscopy were studied frequently and minute histologic studies were made at various times after death. The fundus of the normal adult dog differs from the human fundus in that it has a tapetum lucidum, a much more heavily pigmented choroid, and no macula or fovea. The tapetum, which is limited to the central area of the fundus, and is situated between the pigment epithelium layer and the choroid proper, varies in color from a light lemon yellow through orange to a deep apple green. In the periphery the normal choroid is uncovered. The belief that dogs who hunt by sight possess a macula, while those who hunt by sound and smell do not is not supported by the findings in any of the breeds examined. The cone density was found to be quite heavy and remarkably constant over the whole of the retina. This is also true of the ganglion cells which are much more numerous than in man and evenly distributed over the whole of the retina. Postmortem histologic changes were seen to occur within five minutes particularly in the layers of the retina; the nuclei began to show pyknosis which progressed steadily to complete degeneration of the retina at the end of 18 hours. This process of degeneration was quite similar and constant in all the eyes. Morris Kaplan.

Rossi, A. **Structure of normal vitreous as seen by the contrast phase microscope.** Rassegna ital. d'ottal. **22**:67-84, Jan.-Feb., 1953.

Rossi, using fresh material from rabbits, has attempted to explain the often divergent views of anatomists, embryologists and ophthalmologists regarding the structure of the vitreous. No fibers or other structures were identified, but after an interval of 10 to 30 minutes, crystals of various forms were observed. In the human vitreous, however, fibers disposed in irregular manner form a network. In all cases, where the vitreous was treated with a fixative, an irregular fibrous structure was seen. This is believed to be the result of the action of the fixative upon the protein of the vitreous and seems to be hyaluronic acid and globulin protein. (22 figures) Eugene M. Blake.

Sato, T., and Komori, M. **Histology after the posterior incision of the cornea.** Acta Soc. Ophth. Japan **57**:710-712, July, 1953.

Sato and his collaborators, who first introduced the posterior incision of the cornea as a treatment of conical cornea, myopia and astigmatism, now report on the histologic change of the cornea after incision to study the anatomic effect. Immediately after the incision, there is a considerable retrocession of the cut edges of Descemet's membrane. Within three days, there is an edema in the corneal stroma in the immediate vicinity of the incision. A cellular infiltration, however, never occurs in the stroma throughout the whole course and there is finally a perfect recovery of corneal transparency. In the course of three weeks, an "endothelial connective tissue" not only fills up the gap but it swells out of the gap in spindle form. The cut edges of Descemet's membrane will not ever join together. (5 figures, 22 references) Yukihiko Mitsui.

## 2

## GENERAL PATHOLOGY, BACTERIOLOGY, IMMUNOLOGY

Alexander, B. **Sarcoidosis.** Tr. Canad. Ophth. Soc. **5**:138-148, 1952.

Among 66,000 surgical specimens a diagnosis of sarcoidosis was made in 19.

Among 7,600 autopsies sarcoidosis was an unexpected finding in three. Six cases of Boeck's sarcoid involving the eye are described. A 70-year-old man presented a tumor of the orbit. Roentgenograms of the hands showed radio-translucent areas of the middle phalanx of the right index finger. Biopsy from the orbit revealed a typical granulomatous mass. Another patient showed a granulomatous mass on the palpebral conjunctiva and changes in the skin, lungs, larynx, lymph nodes, and phalanges. One had a tumor of the palpebral portion of one lacrimal gland with epithelioid tubercles. The other had one form of iritis or another and evidence of sarcoidosis in other tissues. (5 figures, 16 references) John V. V. Nicholls.

Bocci, G. **Primary sensitization of the conjunctiva.** Boll. d'ocul. **32**:311-315, May, 1953.

Rabbits were sensitized with the diagnostic anatubercolina (Petragnani). A definite although transient local sensitization of the conjunctiva was achieved by intravenous injection performed 15 days after preparatory treatment. (references) K. W. Ascher.

Michaelson, I. C. **Proliferation of limbal melanoblasts into the cornea in response to a corneal lesion.** Brit. J. Ophth. **36**:657-665, Dec., 1952.

This experimental study indicates that proliferation of the limbal melanoblasts into the cornea is apparently, under certain circumstances, a constant reaction to an experimental lesion of the cornea in the rabbit; that the proliferation has certain features in common with the vascular proliferation and occurs at the same time; and that both proliferations are probably due to the same stimulus. The pigment is always fairly closely confined to this triangular vascular area, with its base at the limbus and its apex directed towards the corneal wound. A gap in the limbal pigment ring was noted in 80 percent of the preparations, using a magnification of ×17. The gap was opposite the base of the area of vascularization or pigment intrusion.

Proliferation of the limbal melanoblasts takes place in response to a lesion placed in the cornea within a critical distance from the limbus and over an extent roughly corresponding to the vascular proliferation. The melanoblasts which proliferated into the cornea tended to lose their pigment. Actual proliferation of the pigment cells is in the direction of the corneal wound. Melanoblasts tend to lose their pigment in the conditions of rapid proliferation. Pigment cells quickly resume their capacity to form pigment under the influence of radiation.

Orwyn H. Ellis.

## 3

## VEGETATIVE PHYSIOLOGY, BIOCHEMISTRY, PHARMACOLOGY, TOXICOLOGY

Adrogue, E., and Diez, M. A. **Comparative value of different miotic drugs.** Arch. oftal. Buenos Aires **28**:37-38, Jan., 1953.

A study was made on 20 normal persons to measure the relative effectiveness of these miotics: 1-percent aqueous solution of pilocarpine, 0.1-percent aqueous solution of diisopropylparanitrophenylphosphate, prepared by the Ulzurrum Laboratory of Madrid, under the name of Micoticol, and a 0.1-percent oily solution of isopropyl fluorophosphate prepared by the laboratory Boots of Nottingham under the name of D. F. P. Observations were made on the changes in the pupillary diameter after a preliminary instillation of a 5-percent aqueous solution of homatropine hydrobromide. The observations were made with a Wessely keratopupil-

lometer. The results, presented as a graph, show that pilocarpine merely prevented enlargement of the pupil, Micoticol contracted the pupil approximately 1 mm. after 30 minutes, and 2 mm. after 60 minutes, and D. F. P. was more powerful. After 30 minutes the pupil contracted to half its size and after 60 minutes to less than 2 mm. Joseph I. Pascal.

Auricchio, G. **Metabolism of the detached retina.** Boll. d'ocul. **32**:287-300, May, 1953.

In 22 eyes of 20 patients with retinal detachment, of a duration of between two weeks and six months, the subretinal fluid was withdrawn and examined for its glucose, pyruvic acid, and lactic acid content. The pyruvic acid and lactic acid content of the blood was ascertained the same day. The same substances were determined in the vitreous of normal eyes and of eyes with lacerations without detachment. The longer the detachment lasts, the more lactic and pyruvic acid will be found in the vitreous. In the early stages of retinal detachment, glycolysis is suppressed and oxydation is more powerful; later, the oxydative metabolism suffers markedly. (2 tables, references)

K. W. Ascher.

Boles-Carenini, B., and Cima, V. **Herpetic infections, antihistamins and cortisone.** Boll d'ocul. **32**:413-421, July, 1953.

Twenty-eight rabbits with experimental herpetic infections of the cornea were treated with benadryl and antistin by topical application; some beneficial effect was noted and explained; the drugs were applied hourly for three days, and later every three hours. Cortisone ointment, 0.5 percent, applied in the same way, did not have any curative effect; in some instances it seemed even to facilitate a spread of infection to the central nervous system. (25 references) K. W. Ascher.

Bonavolonta, Aldo. **The action of cortisone on the corneal sensibility, the pupil and the ocular tension.** Ann. di ottal. e clin. ocul. **79**:343-346, June, 1953.

Cortisone could not be demonstrated to have an influence on corneal sensibility, on the pupil, or on the ocular tension.

John J. Stern.

Bornschein, H., and Vukovich, V. **The electroretinogram in deficiency-hemeralopia.** Arch. f. Ophth. **153**:484-487, 1953.

In a case of vitamin A-deficiency the authors found a reversible disappearance of all the oscillations of the normal electroretinogram. In congenital hemeralopia the b-wave was missing. Different results for the two types of hemeralopia were also obtained when the dark-adaptation was studied. Ernst Schmerl.

Camblaggi, A. **Action of amino acids on the retinal light sensitivity.** Boll. d'ocul. **32**:271-286, May, 1953.

With the adaptometer of Engelking-Hartung, set at 0.17 lux, the adaptation was tested after 20 minutes of fixation of a bright surface. The adaptation curves were compared with those obtained after intake of racemic methionine, left glutamic acid, cystine, left cysteine, alpha-amino-valerianic acid, racemic valine, histidine and a mixture of amino acids, Roche's "Naehrpraeparat 5050/97." Tables show the threshold changes and the graphs of adaptation changes in 62 experiments conducted on different subjects. A summarizing graph describes the increase in adaptation in ten persons taking left glutamic acid. A less impressive increase in adaptation was found after intake of left cysteine. No effect was obtained by use of the other substances. (references)

K. W. Ascher.

Ciocatto, E., and Garzino, A. **Ophthalmological observations of the action of curare injected into the carotid artery in**

**non-anesthetized subjects.** Rassegna ital. d'ottal. **22**:184-191, March-April, 1953.

The method proposed permits the introduction of curare in high concentration by using small doses and distributing the drug in the region supplied by the carotid. Thus the nervous tissues affecting the eye can be well studied. The first result of the injections is a fall in blood pressure, soon followed by recovery. The extraocular and palpebral muscles undergo a complete paralysis which is prolonged, depending upon the dosage. No definite effect upon the intra-ocular musculature was observed, nor was the ocular tension affected. Only with a fairly strong solution was there a dilatation of the retinal veins and hyperemia of the disc.

Eugene M. Blake.

Cucco, G. **Spasmolytic action on the retinal artery. (Experimental clinical study with nicotinamide-1-2 diphenylethane.)** Ann. di ottal. e clin. ocul. **29**:157-168, March, 1953.

A new vasodilator ("Lyspamina") was tested on normal persons in whom an artificial arteriospasm was produced by an adrenergic drug ("Simpomina"). The blood pressure was taken and the pressure of the retinal arteries measured with the ophthalmo-dynamometer. While the adrenergic drug alone caused a considerable rise in both measurements, a combination of it with the vasodilator considerably reduced the rise of blood pressure, both in the peripheral and the retinal arteries.

John J. Stern.

De Berardinis, E., and Bonavolonta, G. **Experimental study of the passage and concentration of cortisone into the aqueous and vitreous.** Rassegna ital. d'ottal. **22**:157-167, March-April, 1953.

By means of a qualitative method, using the reagent 2-3-5 triphenol-tetrazolio, it was possible to determine that cortisone passes into the aqueous after instillation and after subconjunctival injection. In the normal aqueous, the qualitative result was sometimes poorly positive in revealing the presence of traces of cortisone. Employing the quantitative procedure of Porter and Silber, it was established that minimal quantities of cortisone are present, about 41 gamma/ml., that after instillation, subconjunctival, and intramuscular injection cortisone passes into the aqueous and vitreous, and that the aqueous of second formation contained about three times as much cortisone as the primary aqueous.

Eugene M. Blake.

D'Ermo, F. **Clinical and experimental study of a new mydriatic.** Boll. d'ocul. **32**:341-348, June, 1953.

Isolated strips of iris, the pupil of living rabbits, and human pupils and accommodation were tested with beta-diaethylamino-aethyl-xanthen-9-carboxylate. The action was compared to that of atropine and proved to be much less powerful and of shorter duration. A slight and transient decrease of accommodation was recorded. The substance, called avagal, may be used for diagnostic and therapeutic purpose when other mydriatics are not tolerated. (8 graphs, 1 table)

K. W. Ascher.

Desvigne, P., Baron J., and Schapira. **Ophthalmic biochemistry.** Semaine d. hôp. Paris **29**:2947-2970, Oct. 6, 1953.

In a series of articles planned under the direction of Professor Desvigne, he and his associates display the elementary ideas associated with ions, Donnan equilibrium, dialysis and ultrafiltration, and discuss the fundamental concepts of the biochemistry of the aqueous, the cornea, the lens, pigment, and the vitreous, and the pharmacodynamics of the muscles of the iris.

F. H. Haessler.

Jaeger, A. **The flow of the aqueous humor in the aqueous veins.** Arch. f. Ophth. **153**:504-509, 1953.

This is a short discussion of some of the phenomena observable in bloodvessels which receive aqueous humor from aqueous veins. The reader interested in rheology will find a helpful introduction to the subject in Howell-Fulton's textbook of physiology. Ernst Schmerl.

Klein, M., and Millwood, E. G. **Chloramphenicol applied in calcium alginate caps for the control of experimental corneal infection with Pseudomonas pyocyanea.** Brit. J. Ophth. **36**:679-682, Dec., 1952.

The use of locally applied chloramphenicol as a prophylactic against experimental corneal infection with Pseudomonas pyocyanea is investigated. A single dose of chloramphenicol powder administered in calcium alginate caps gave protection against experimental pyocyanea infection of rabbit corneas in two eyes out of six. This result compares unfavourably with the effect of streptomycin; a single dose of streptomycin powder in calcium alginate caps or glycerin-gelatin discs gave almost certain protection. The application of nonmedicated calcium alginate caps caused a transitory corneal haze in healthy rabbit eyes. Orwyn H. Ellis.

Lian, Sie-Boen. **Experimental transplantation of sclera into cornea.** Ophthalmologica **124**:287-292, Nov., 1952.

Full-thickness discs of sclera grafted into the cornea of the same animal (rabbit) undergo some clearing. Lamellar scleral grafts placed either in the cornea or into the anterior chamber remain opaque. (7 figures, 4 references) Peter C. Kronfeld.

Montanari, L., and Lepri, G. **Corticoid in primary and secondary aqueous.** Rassegna ital. d'ottal. **22**:305-307, May-June, 1953.

The authors have verified the studies of Leopold and Mayloth, who demonstrated the presence of corticoids in the aqueous of normal rabbits and its presence in greater amounts after one or more paracenteses. The corticoids are present in higher concentration in the aqueous than in the blood stream. (1 graph, 3 references) Eugene M. Blake.

Morone, G. **The action of cocaine on the amino-oxidase activity of the iris.** Ann. di ottal. e clin. ocul., **79**:377-380, July, 1953.

Using homogenized iris tissue of albinotic rabbits and checking the oxidation rate of tiramine the author found that the addition of cocaine slightly enhanced the amino-oxidase activity of the iris tissue. (7 references) John J. Stern.

Rizzo, P. **A new miotic, physostin, and its actions on normal and glaucomatous eyes.** Boll. d'ocul. **32**:321-332, June, 1953.

A miotic, similar to furmethid, was synthetized by Carlo Erba, Milan; it is trimethyl-furfuryl-ammonio-para-toluen-sulfonate, and was applied in 10-percent solution. Fifteen minutes after instillation, it produced marked miosis lasting maximally ten hours with a peak of action within an hour after application. It does not contract a pupil enlarged by atropine instillation. In normal eyes it lowers the intraocular pressure for six to seven hours or slightly more; the pressure drop ranged between 1 and 6 mm. Hg. On 50 patients with different types of glaucoma (tables) good results of pressure decrease were obtained in 10 out of 17 eyes with chronic simple glaucoma. Some of the other patients showed fair results of the treatment which consisted of two daily instillations. No harmful side effects were recorded. (references) K. W. Ascher.

Salvi, G. L. **The action of cortisone on the lacrimal lysozyme.** Boll. d'ocul. **32**: 349-356, June, 1953.

Laboratory experiments with micrococ-

cus lysodeikticus showed no effect of cortisone on its growth. Ten normal individuals were tested for their lysozyme action in diluted lacrimal fluid before and after administration of 80 to 100 mg. of cortisone. An inhibition of growth was found two to seven hours after the injection, with a peak between three and four hours after the administration. Instillation into the conjunctival sac and injections under the conjunctiva (five patients) proved inefficient. (1 drawing, 1 graph, references)

K. W. Ascher.

Seidler, Dymitrowska Maria. **Histochemical examination of the eye in relation to age.** Klinika Oczna **23**:1-24, Jan., 1953.

The chemical composition of the eye changes with age and by examining the tissues at different ages some indications of the process of aging may be found. Eyes removed from the dead within the first four hours, were examined for the presence and behavior of ascorbic acid, glutathione, nucleic and ribonucleic acid, and organic calcium. Different parts of the eye were examined separately. Tests showed that vitamin C gradually decreased in the basal layers of the epithelium and appeared in the superficial layers and also decreased in the area of the filtration angle. It was noticed that highly vascularized tissue had very little vitamin C. Glutathione was present in the cornea and the choroid. The reaction decreases after the age of 30 years and is barely noticeable after 60. The amount of ribonucleinic acid decreases with age in the cornea and in the epithelium of the ciliary process. In the ciliary body this decrease parallels the loss of the glutathione, in the cornea it starts much later. Much ribonucleic acid was found in the ganglion cells of the retina at any age. The amount of desoxyribonucleic acid did not depend on age. There was an increase of calcium with age, particularly in the sclera, Bruch's membrane and in the walls of the small blood vessels. (20 references)

Sylvan Brandon.

Siebeck, Robert. **The antagonistic innervation of the accommodation, and the accommodation of the resting eye.** Arch. f. Ophth. **153**:425-437, 1953.

The author examined ten persons using a slight modification of Scheiner's experiment. He found the accommodation of the resting eye equal to 0.6 of a diopter. Drugs affecting the sympathetic had a minor effect upon the accommodation, those acting upon the parasympathetic showed a pronounced action. The author considers a double innervation of the ciliary muscle most probable.

Ernst Schmerl.

Siebeck, Robert. **The effect of drugs upon the accommodation.** Arch. f. Ophth. **153**:438-450, 1953.

The accommodation was studied with the help of Lyle's synoptophore. Various drugs were administered to one of the two eyes. Incomplete paresis produced by homatropine diminished the result of an accommodative nervous stimulus, stimulation of the sympathetic produced the same result as weakening of the parasympathetic. Eserine affected the accommodation to a much higher degree than pilocarpine. The findings favor the assumption of a double innervation of the ciliary muscle.

Ernst Schmerl.

Siliato, Francesco. **The behaviour of cholinesterase in serum and aqueous during treatment with isonicotinic acid hydrazide.** Ann. di ottal. e clin. ocul. **79**:275-281, May, 1953.

Isonicotinic acid hydrazide (I.A.H.) interferes with certain enzymatic processes of the organism (plasma amylase, protease, carbonic anhydrase, lipase). In order to observe its effect on cholinesterase the author examined two groups of guinea

pigs. In the first group cholinesterase in the blood serum and in the aqueous was determined after I.A.H. treatment. In the second group the same determination was made in animals also treated with I.A.H. but in which an anaphylactic shock was produced. The results show that the cholinesterase activity in the serum and the aqueous is increased in animals treated with I.A.H. It is concluded that I.A.H. behaves like a sympathicomimetic substance. The clinical effect of I.A.H. in tuberculosis might point to a hypersympathicotony or a depression of the parasympathetic system in this disease. (7 references) John J. Stern.

Topalis, C., and Bohringer, H. R. **Injections of cortisone into the anterior chamber of the rabbit.** Arch. d'ophth. **13**:397-406, April, 1953.

In a series of experiments with rabbits the authors found that injections of from 1 to 2 mg. of cortisone acetate into the anterior chamber were well tolerated. Higher doses, or repeated injections, led to transitory corneal edema and to more lasting subepithelial degenerative changes. Drawings illustrate these changes which seemed to involve the pupillary areas predominantly. A single injection of cortisone into the anterior chamber in experimental anaphylactic uveitis had no favorable effect but rather seemed to prolong the inflammatory reaction. (6 figures, 9 references)
Phillips Thygeson.

## 4

## PHYSIOLOGIC OPTICS, REFRACTION, COLOR VISION

Asher, H. **Stimulus to convergence in normal and asthenopic subjects.** Brit. J. Ophth. **36**:366-675, Dec., 1952.

The conscious estimate of the position of an object (the proximal factor) plays a part at least as important as accommodation in determining convergence. The influence of this factor varies greatly from one individual to another. Tests are described for measuring the effects of convergence at a long and short distance. At long range, for nearly all asthenopic patients, the estimate of range predominates and prevents convergence, despite the accommodative effort induced by concave lenses (this is a result which could be applied to diagnosis). At short distances the proximal factor affects the amount of latent squint induced by the wearing of positive lenses, and its measurement intimately concerns the appropriate correction for presbyopia and hypermetropia.
Orwyn H. Ellis.

Fabre, Philippe. **Scheinerian rehabilitations. (Réhabilitations scheineriennes).** Arch. d'opht. **13**:366-373, April, 1953.

The author notes that the contributions of P. Scheiner to the science of optics do not need revival but only review since they are already incorporated in our knowledge of physical and physiological optics. The present report discusses the application of some Scheinerian principles to the measurement of refraction. (5 figures, 4 references) Phillips Thygeson.

Junker, H. **Determination of the true horopter with the help of the oscillation method.** Arch. f. Ophth. **153**:471-476, 1953.

The author describes how he had determined the empirical horopter with a special instrument. However, apparatus and curves were lost during the war.
Ernst Schmerl.

Knox, G. W. **Some effects of auditory stimuli on the perception of visual flicker.** Am. J. Optometry **30**:520-525, Oct., 1953.

Some investigators have reported a change in the critical flicker frequency with simultaneous sound stimuli. This was investigated in several ways by use of a musical tone 1,000 cycles per second at

50 decibels, interrupted or steady, applied by ear phones. In five subjects there was no apparent change in CFF. However, when the flickering light was maintained at 18 or 26 flashes per second, the flickering seemed more pronounced in the presence of sound. The effect was most noticeable with 15 sounds per second, and least with 35 sounds per second which fused. Paul W. Miles.

Komiya, K. **A basic study of pseudo-isochromatic tables.** Acta Soc. Ophth. Japan **57**:583-587, July, 1953.

The equation zone of brightness between gray and color was studied. The zone is narrow in red anomalies and is nearly as wide as normal in green anomalies. Anomalous patients can differentiate gray from color even in the equation zone of brightness. (5 figures, 1 table) Yukihiko Mitsui.

Law, Frank W. **Reading types.** Brit. J. Ophth. **36**:689-690, Dec., 1952.

After extensive study it is recommended that reading types be standardized on a strictly scientific basis and be of pleasing standard graduated types. The selected passages should not be too simple and different passages should be used for each test size. The standards as to type, specimen, contents, paper and make-up are listed. Orwyn H. Ellis.

Manabe, S. **A study of flicker electroretinogram.** Acta Soc. Ophth. Japan **57**: 591-601, July, 1953.

In the first part, the author describes his studies of the effect of some medicaments such as epinephrine, eserine and potassium chloride on the usual ERG of the isolated frog's eye, in the second part his studies of the flicker ERG followed until fusion occurred, and, lastly the effect of these medicaments on the flicker ERG. In the flicker test, the ERG looks like a sign curve when the ratio of flash and interval is 1 to 1. If the ratio is 1 to 5 an antelocation of the peak of waves is brought about, and if 5 to 1 a retrolocation. After a discussion of other results he concludes that a- and d-waves play the most important role in the flicker ERG and that the d-wave does not seem to be the result of interference between other waves. It seems to represent an independent process. (11 figures, 2 tables, 20 references) Yukihiko Mitsui.

Niedermeier, S. **Examination of night vision with a radium adaptometer.** Klin. Monatsbl. f. Augenh. **123**:230-231, 1953.

The patient is asked to arrange a number of small cylinders according to the size of the illuminated field and according to their brightness. The illumination is produced by radioactive dyes. The time which the patient needs to arrange these cylinders correctly is measured in a dark room. (2 figures) Frederick C. Blodi.

Parsons-Smith, G. **Flicker stimulation in amblyopia.** Brit. J. Ophth. **37**:424-431, July, 1953.

Fifty children with strabismus and amblyopia who were undergoing orthoptic treatment were subjected to a standardized white light flicker routine. The studies showed that in the majority of cases the cortical response was the same whether the amblyopic or the sound eye was stimulated and although there was some variety of response, all of the responses must be dependent on normally-functioning pathways. There was, however, a small group in which abnormality of response was found in the amblyopic eye. This indicated some interference with the pathways since the stimulus did not reach the cortex. Morris Kaplan.

Pasino, Luigi. **Comparative data obtained by the perimeters of Maggiore and of Goldman.** Rassegna ital. d'ottal. **22**:318-329, May-June, 1953.

The two types of perimeters appear to have equal value, each showing certain advantages in some respects, while the others give better service from another point of view. (10 figures, 6 references)

Eugene M. Blake.

Pau, H. **The forces operative in the lens during accommodation.** Ophthalmologica **124**:271-278, Nov., 1952.

The increase in lens surface curvature during accommodation is not of sufficient magnitude to account for the concurrent increase in refractive power. This difference, according to Gullstrand, is due to processes within the lens which are comprised under the term intracapsular accommodation. Differences in refractive index between nucleus and cortex and different rates of axis-ward movement of the various layers of the lens during accommodation are the essential points in Gullstrand's concept. The author of the paper under review analyzes the premises of Gullstrand's concept and finds them only partly valid. (42 references)

Peter C. Kronfeld.

Pettinati, Sergio. **Particular projection of X-ray for study of traumatic lesions of the zigoma.** Rassegna ital. d'ottal. **22**:330-338, May-June, 1953.

Radiographs taken from a temporal angle made possible the demonstration of fractures and other pathologic changes which are not evident in the antero-posterior plane. They help to explain the painful symptoms after trauma to the molar and zygomatic area. (5 figures, 15 references) Eugene M. Blake.

Rosenbloom, A. A. **The correction of unilateral aphakia with corneal contact lenses.** Am. J. Optometry **30**:536-542, Oct., 1953.

Results in eight patients fitted with the Tuohy lens were good. Contact lenses are more comfortable in aphakic patients than others because of the effect of surgery to reduce sensitivity of the cornea. The advantages include binocularity and normal visual fields. Placing the correcting power on the cornea reduces aniseikonia. Paul W. Miles.

Shikano, S. **A study of the mechanism of light perception in the retina by an analysis of flicker fusion frequency.** Acta Soc. Ophth. Japan **57**:647-656, July, 1953.

In the first experiment the author measured the critical fusion frequency by giving alternative flicker in both eyes. The c.f.f. thus obtained is essentially the same as that obtained by monocular or binocular, simultaneous tests. He therefore considers the flicker fusion to be not a central but a retinal process. In the second experiment he states that the curve obtained by plotting the logarithm of light intensity against c.f.f. looks almost straight but, when exactly observed, there is a slight bend at the point of 24-frequency and 0.2 radlux. The curve below the bend should indicate rod fusion and that above the bend cone fusion. In the final experiment he states that c.f.f. by central vision does not depend on the illumination of the background in the range of 0 to 18.5 radlux, while by peripheral vision it is complicated. In high illumination of the flicker object a light background impedes the fusion, and the converse is true in feeble illumination of the object. (9 figures, 1 table)

Yukihiko Mitsui.

Starkiewicz, W. **Application of examination of visual acuity in determination of degree of ocular lesions.** Klinika Oczna **23**:41-56, Jan., 1953.

The author defines functional and absolute visual acuity and shows by formulas the relation between the absolute and relative visual acuity. On the basis of these considerations one can determine the degree of loss of vision due to pathologic

conditions, and eliminate the influence of the optic system of the eye in judging this loss. (17 figures, 3 references)

Sylvan Brandon.

Vukovich, V. **The electroretinogram of the achromate.** Ophthalmologica **124**:354-359, Dec., 1952.

Since the electroretinogram (ERG) represents the algebraic sum of the electric activities of several different retinal systems, the study of congenitally defective, that is simpler, retinas promises to be particularly revealing (cfr. Am. J. Ophth. 35:1870, 1952). The paper under review deals with the ERG in a case of typical, congenital, total color blindness. The x-wave was completely absent, the a-wave very much diminished, the b-wave only moderately diminished. On the whole the ERG of the achromate closely resembled the peripheral ERG of the normal. These findings suggest that the x-as well as the a-wave are expressions of the cone-function. (4 figures, 5 references). Peter C. Kronfeld.

Wacholder, K., and Arnold, H. **Vegetative regulation of the performance of the organs of light sense.** Schweiz. med. Wchnschr. **83**:1503-1506, Sept. 19, 1953. (Beiheft zu. No. 38.)

Determination of flickerfusionrate not only showed that the performance of the tissues important in light sense can be influenced by the injection of a sympathetic and parasympathetic stimulant, but suggests that such autochthonous stimulants normally play a part in its regulation. F. H. Haessler.

Wagenaar, J. W. **The importance of the relationship between figure and ground in fast traffic.** Ophthalmologica **124**:309-315, Nov., 1952.

Most of our visual perceptions are examples of a clear-cut, harmonious figure and ground relationship. Our judgments based on such perceptions are definite and accurate. Geometric or artistic patterns in which the ground is given some or all the attributes of the figure are confusing. Such situations of competition between ground and figure may affect the judgments of the driver of an automobile who at dusk comes under the influence of the headlights of an oncoming car. The experienced driver is not actually dazzled, but may be confused by the co-existence of negative and positive silhouettes. (5 figures) Peter C. Kronfeld.

Westheimer, G. **The effect of spectacle lenses and accommodation on the depth of focus of the eye.** Am. J. Optometry **30**:513-519, Oct., 1953.

Formulas for estimating the range of clear vision through multifocal lenses in various degrees of ametropia, reading additions, and pupil sizes were derived from theoretical size of the blur circles limiting the vision to 20/15 or to 20/20. Depth of focus was found to be slightly greater in corrected myopia than in hypermetropia. This is reasonably expected on the basis of the magnification of spectacle lenses. The resulting ranges of clear vision for the 20/15 level are smaller than those generally accepted. Paul W. Miles.

Yonemura, D. **The relation of threshold of stimulus in electrical phosphene to adaptation.** Acta Soc. Ophth. Japan **57**:587-591, July, 1953.

A curve was plotted to represent the threshold of voltage against stimulation time, taking an electrical phosphene elicited by a constant current pulse as the index. In dark-adapted eyes the curve is hyperbolic. In light-adapted eyes there is a lowering of the threshold in general. The lowering is highest when the stimulus has a duration of 20-30 msec., and light adaptation is for 0.0028-0.4 ml. white illumination. It decreases with an increase of intensity of illumination for light adaptation. When color is used in the adapta-

tion, the lowering is obvious only by adaptation to shorter waves than 530 mμ (rod adaptation), but negligible by longer waves than 605 mμ (cone adaptation). The author believes that these facts indicate that the lowering is chiefly related to rod adaptation and the function of the rods is highly impeded by cone adaptation, therefore, by usual light adaptation. He further states that by peripheral adaptation to 510 mμ wave at 0.09 ml., the lowering of the threshold is highest when the field of 20 degrees on the nasal side of the macula is illuminated, corresponding to the site with compact distribution of rods. (5 figures, 15 references)

Yukihiko Mitsui.

## 5

## DIAGNOSIS AND THERAPY

Badia, J. A., and Magnin, P. H. **Therapeutic results from treatment of ocular rosacea by chloramphenicol.** Arch. oftal. Buenos Aires **28**:23-28, Jan., 1953.

Two cases of ocular rosacea which were successfully treated only with chloramphenicol are presented. After a review of the literature the authors attribute the lack of success in some cases to infection with a strain of bacteria more resistant to this antibiotic. The patients treated received 30 grams of chloramphenicol daily. However, half this dose can bring about a remission of the ocular lesions and the disappearance of the papules and pustules from the face.

Joseph I. Pascal.

Beauvieux, J., Blanquet, P., and Maraud, R. **Radio-isotopes in ophthalmology.** Arch. d'opht. **13**:349-365, April, 1953.

This review, from the radio-isotope laboratory of the Bergonie Foundation and the histology laboratory of the Faculty of Medicine of Bordeaux, gives a well-documented survey of the present status of radio-isotopes in ophthalmology. The authors consider the use of isotopes in studying the penetration of different substances into the globe and compare the new methods of analysis with the old classical methods. They conclude that the use of the isotopes has established the existence of a true barrier between the blood and the aqueous, or more specifically between the capillary blood and the fluid of the uveal tract. They further describe other applications of the isotopes, giving important information in the fields of pharmacodynamics and therapeutics. They conclude with a report of their own studies on the penetration of iodine into the rabbit eye as a result of the conjunctival instillation of a collyrium of sodium iodide of 1:1,000 concentration, to which was added a tracer dose of the isotope (iodine 131). All tissues of the eye showed measurable concentrations, with the cornea showing maximum and the vitreous minimum readings. (3 figures, 28 references)

Phillips Thygeson.

Bremer, H. **Topical anesthesia in ophthalmology.** Klin. Monatsbl. f. Augenh. **123**:225-228, 1953.

Cornecain is a new synthetic anesthetic which has the same efficacy as pontocain, but is less irritating. It is used as a 3-percent solution and does not dilate the pupil. It is well suited for use in removing superficial foreign bodies in tonometry, and for subconjunctival injections. (3 references)

Frederick C. Blodi.

Cartesegna, F. **General anesthesia in ocular surgery of infants.** Rassegna ital. d'ottal. **22**:36-49, Jan.-Feb., 1953.

General anesthesia was administered in 208 instances of ocular surgery in patients aged from 15 days to 18 years. The great advantages of the procedure and the almost complete safety are emphasized. The usual anesthetic employed was a barbiturate.

Eugene M. Blake.

Choyce, D. P., and Cross, A. G. **An eye sanatorium. A survey of one year's work.** Brit. J. Ophth. **37**:405-414, July, 1953.

In England a sanatorium of 28 beds was organized which is used exclusively for cases of ocular tuberculosis and is under the combined supervision of a chest sanatorium and the Moorfield's group of eye hospitals. In the first year of its existence 47 patients have been treated and discharged. The average length of stay was four months and ranged from two to 12 months; the patients received detailed clinical study and were treated with all the newest antituberculosis drugs as well as tuberculin desensitization. About one-fourth of the lesions were Boeck's sarcoid which was accepted as a type of tuberculosis. Morris Kaplan.

Daenen, P. **Correction of ametropia in visual field studies.** Arch. d'opht. **13**:384-390, April, 1953.

The author stresses the contribution of the Goldmann perimeter in improving the accuracy of visual field studies. In an analysis of the role of ametropia in perimetry, he concludes that the use of correcting lenses to give good vision at 33 cms. is necessary for accurate measurement of middle and central isopters of the visual field and that each perimeter should be provided with an accessory permitting use of correcting lenses. He stresses that the use of such lenses is mandatory in some cases, e.g., of high myopia and aphakia. The study is documented by case histories and by a consideration of the prismatic effects induced by plus and minus corrective lenses. (7 figures)

Phillips Thygeson.

Davini, V. **The variation of the pressure of the retinal artery after pneumoencephalography with varying amounts of air.** Ann. di ottal. e clin. ocul. **79**:347-358, June, 1953.

The measurement of the retinal arterial pressure before and after lumbar pneumoencephalography showed some differences depending on the amount of air injected. Subjects injected with 35 cc. of air or more showed an increase, those injected with 25 cc. or less, a decrease of previous pressure records. The injection of 30 cc. can produce either one reaction or the other. (66 references) John J. Stern.

François, J., Moens, R., and Moens, R. **A new electronic tonometer.** Brit. J. Ophth. **36**:694-697, Dec., 1952.

A new electronic tonometer is presented. Standardization, calibration and comparison with present equipment and intraocular manometer will be done.

Orwyn H. Ellis.

Harrington, D. O. **Perimetry with ultraviolet (black) light and luminescent test objects.** Tr. Am. Acad. Ophth. **57**:616-619, July-Aug., 1953.

This instrument has an arc whose radius of curvature is 330 mm. and a width to simulate a portion of a hollow sphere and thus allow for a degree of scotometry within the confines of this width without rotation of the arc. Illumination is uniform and constant on all portions of the arc. The arc and illuminating system are mounted on an adjustable microphone stand, thus eliminating the need for a table and allowing for easy adjustment to varying heights for greater patient comfort. The arc surface of the perimeter is covered with felt or ultraviolet-absorbing dull black paint, to minimize reflection. The illuminating tube is parallel to the perimeter arc so that when the arc is in the vertical position the entire instrument requires a minimum of storage space when not in use. Except for the weighted base, which increases stability, the perimeter is constructed entirely of aluminum and may be wheeled on its casters from one room to another with little effort. It does not require a separate "perimeter

room" for its use. Standard Berens' test objects may be used with the white light perimeter. A complete set of "Lumitest Objects" plus a dull black ultraviolet absorbing wand to carry the objects is included with the "black light" model. The instrument is less expensive than most comparable models.

Theodore M. Shapira.

Henderson, J. W. **Intracavitary optic radon applicator.** Tr. Am. Acad. Ophth. **57**:614-615, July-Aug., 1953.

The advantages of this applicator are: it is possible to "pinpoint" the area of therapy rather than to irradiate the entire posterior segment of the eye; the treatment time is reduced to a few hours; the dangers of scatter emanations are reduced to a minimum; the dangers of changes in the skin subsequent to the external applications of radium are eliminated, and the chances of the development of cataract are decreased.

Theodore M. Shapira.

Kapuscinski, W. J. **Methods of differential diagnosis in tuberculous and focal infection of the eye.** Klinika Oczna. **23**:25-40, Jan., 1953.

The author traces the development of ideas about the etiology of the infection of the uvea. Tests for differentiating tuberculous from focal infection of the uvea are described. Typhoid vaccine intravenously is used as a stimulating agent. It acts on the reticuloendothelial system and on the pituitary which mobilizes the corticosteroids. After intravenous injection of typhoid vaccine the sedimentation rate is increased when a tuberculous process is in a stage of exacerbation. The presence of focal infection in the teeth can be determined by applying high frequency current to a suspected tooth and measuring sedimentation rate afterwards. In focal infection the Mantoux reaction disappears after intravenous injections of typhoid vaccine and the condition improves. When the inflammatory lesion is tuberculous the Mantoux reaction increases and the condition of the eye gets worse. Cells in the aqueous after the intravenous typhoid injection show a relative shift to lymphocytes and leukocytes in tuberculosis, and a shift to monocytes and reticulocytes in focal infection. Permeability of capillaries and of the blood aqueous barrier is decreased after injection of the typhoid vaccine in focal infection. Antistine does not affect it. (50 references)

Sylvan Brandon.

Lister, A., Philps, A. S., and Langham, M. **The measurement of the corneal thickness and its application to keratoplasty.** Brit. J. Ophth. **37**:436-438, July, 1953.

Variations in thickness of the host cornea in keratoplasty cause many complications and add much to the difficulties of the procedures of either lamellar or full-thickness grafting. Estimation of thickness by ordinary slitlamp observation helps, but is not exact. The authors describe an accessory made for attachment to the slitlamp which accurately measures corneal thickness and so adds immeasurably to the planning and execution of the surgical procedure. The accessory instrument is that devised and described by Maurice and Giardini (see Brit. J. Ophth., 35:169, 1951.)

Morris Kaplan.

Littmann, H. **A note on the Zeiss-Opton slitlamp.** Arch. f. Ophth. **153**:553-556, 1953.

The author adds geometric optical considerations to a paper published in this Journal 33: 1863, 1950. Ernst Schmerl.

Morpurgo, F. **The examination of the eyeball with variable monochromatic light (first communication).** Ann. di ottal. e clin. ocul. **29**:195-206, March, 1953.

Blood vessels of the conjunctiva were

observed in monochromatic light the wavelength of which could be changed; by increasing the wavelength from 575 millimicron a point can be reached where the vessels are undistinguishable from the background (value L), and by decreasing it from a longer wavelength to a shorter one another point of disappearance is observed (value K). The arithmetical mean value LK is characteristic and changes with the degree of oxygenation of the blood. This value could be observed to undergo changes parallel to the clinical course of inflammation of the anterior segment. John J. Stern.

Morpurgo, Fabio. **Examination of the eyeball with variable monochromatic light (second communication).** Ann. di ottal. e clin. ocul. **79**:297-306, May, 1953.

In a previous communication, the use of variable monochromatic light in the examination of the conjunctival vessels was described. In this paper the same technique was used for study of the retinal vessels. By observing the absorption wave lengths of the vessels in various conditions, alterations could be found which were not visible in ordinary ophthalmoscopy. (3 references)

John J. Stern.

Neely, J. C. **A speed-of-perception measurement apparatus.** Brit. J. Ophth. **37**:439-443, July, 1953.

The accommodation tachometer is an instrument built by the R.A.F. which is used for the measurement of the speed of accommodation. The speed of change can be measured in both directions. The far object is viewed at 22 feet and the near at two feet and the speed of recognition is measured by an electric timing device. The objects are letters as well as objects familiar to airmen and the whole instrument is portable so that it may be used in aircraft as well as in decompression chambers. With it one can study effects on accommodation of such factors as fatigue, excitement, danger, speed, and various drugs and it will serve as an aid in selection of men for the various highly specialized military functions.

Morris Kaplan.

Norton, H. J. **Absolute three dimensional colored retinal photographs.** Tr. Am. Acad. Ophth. **57**:612-613, July-Aug., 1953.

The unit is practical because it is composed of instruments readily available; the adaption necessitates only temporary alteration of camera and ophthalmoscope permitting each to be used for other purposes if so desired; the pictures are made on the new standard stereokodachrome film of Eastman Kodak Co., the adaption does not require elaborate accessories; it is the only photographic device at present which permits taking absolute stereokodachromes of the retina; the photographs compare favorably as to degree of magnification and extent of field with pictures obtained by other photographic units and the films are three dimensional. Theodore M. Shapira.

Palich-Szanto, O. **Fundus changes in lues, especially lues latens.** Klin. Monatsbl. f. Augenh. **123**:208-223, 1953.

244 patients were examined and 101 showed changes in the fundus. These changes were partially reversible and did not interfere with vision. They were confined to the disc, where there was edema with blurring of the disc margin, connective tissue formation, or sheathing. These changes may be of diagnostic importance in latent syphilis. (5 figures, 39 references) Frederick C. Blodi.

Pettinati, S. **Radiological study of the external orbital border.** Rassegna ital. d'ottal. **22**:209, March-April, 1953.

Pettinati urges the more frequent employment of oblique projection in the

study of the orbital rim, especially the outer border. The antero-posterior projection is obscured so often by dense petrous bone and the nasal accessory sinuses that fractures and other abnormalities are not revealed. This is demonstrated by X-ray films which are reproduced. (3 figures) Eugene M. Blake.

Santalices Muniz, Faustino. **An improved manual suction cup for cataract extraction.** Arch. Soc. oftal. hispano-am. **13**:570-573, May, 1953.

The chief characteristic of this suction cup is the almond-shaped form externally, with a 1 mm.-prolongation anteriorly in the form of a visor to facilitate its insertion through the pupil. It does not have the bevel found in the other suction cups, and its margins are round. This diminishes its size and with it the risk of including the iris in the suction. (3 figures) Ray K. Daily.

Theodore, F. H., and Feinstein, R. R. **Preparation and maintenance of sterile ophthalmic solutions.** J.A.M.A. **152**:1631-1633, Aug. 22, 1953.

Recent government regulations now insure the sterility of commercially prepared ophthalmic solutions. The more common contaminants are Pseudomonas aeruginosa, bacillus-proteus, varieties of streptococcus, pneumococcus and Aspergillus fumigatus. A technique of filtration and sterilization is described and 5-percent chlorobutanol is recommended as a preservative. Irwin E. Gaynon.

Troutman, R. C. **"Steretainer": a new device for dispensing sterile ophthalmic solutions.** Tr. Am. Acad. Ophth. **57**:620, July-Aug., 1953.

The Steretainer was developed to prevent and control infection in operative cases at the Manhattan Eye, Ear and Throat Hospital. These are individual disposable ophthalmic solutions. The Steretainer may be cold sterilized for operating room use or use as an individual unit on the floors. The device has a perfect seal; the contents are clearly marked in a visible and insoluble ceramic ink. A special rubber is used which is chemically inert and aids in preservation of the solution. A rubber valve is built into the bulb to prevent the solution from entering the bulb from the tube and also to prevent release of the contents when the rubber tip is removed. The solutions are especially buffered and will retain their effectiveness longer than the usually prepared ophthalmic solutions.

Theodore M. Shapira.

## 6

## OCULAR MOTILITY

Coppez, M. Leon. **Pathogenesis of strabismus. Some specific ideas.** Bull. Acad. roy. de med. de Belgique **18**:313-322, 1953.

This is a review of the recent theories of the pathogenesis of strabismus. The authors state that paralytic strabismus, latent strabismus (heterophoria), and concomitant strabismus are being considered more and more as inseparable entities. In concomitant strabismus, while questions of muscle physiology and of the psyche are of importance, the essential factor is the loss of binocular function.

John C. Locke.

Hiroishi, M. **Electro-oculogram in strabismus.** Acta Soc. Ophth. Japan **57**:607-641, July, 1953.

This is an analysis of EOG in 22 cases of strabismus before and after surgery. In strabismus caused by a hypofunction of one muscle there is a lowering of the velocity curve in the movement of the corresponding eye away from the center and toward the direction of the corresponding muscle contraction. The decreasing leg of position record appears

gently sloping. In case of a hyperaction, there are an increase in velocity curve and a gentle sloping of the ascending leg of the position record. These changes are observable mainly in a movement of the corresponding eye in monocular vision and are small in a concomitant movement. The EOG is valuable in the analysis of the nature of strabismus. (24 figures, 22 tables, 8 references)

Yukihiko Mitsui.

Rema, Giovanni. **Strabismus and nystagmus.** Rassegna ital. d'ottal. **22**:245-260, May-June, 1953.

Thirteen cases are reported in which surgical correction of strabismus considerably reduced the nystagmus. In nine of these the nystagmus was considered to be purely ocular; an insufficient power of fixation resulted in motor disequilibrium. Improvement was functional as well as cosmetic. (23 references)

Eugene M. Blake.

Schifferli, Peter. **Photographic registration of eye movements in visual exploration, recognition and representation.** Monatschr. f. Psychiat. u. Neurol. **126**:65-118, Sept., 1953.

A method is described for recording ocular movements by photographing corneal reflections. The results are interpreted in the light of cybernetic hypotheses of cerebral activity and suggest that a functional pattern exists which is common to all ocular movements and is dependent on rhythmical cerebral activity. (9 figures, references) F. H. Haessler.

Toselli, Carlo. **Interference between heterophoria and aniseiconia.** Ann. di ottal. e clin. ocul. **79**:243-250, April, 1953.

Two hundred patients with emmetropia or corrected isometropic ametropia with different forms of heterophoria were examined. The two conditions can exist together or can appear independently of each other. The incidence of basic aniseiconia in heterophoria is not greater than in orthophoria. The disturbances in both conditions are identical and cannot be distinguished clinically. Improvement can be obtained sometimes by correction of one or the other condition alone, or both together. The use of aniseiconic lenses improves the chance to compensate the heterophoria. The improvement of fusion tends to prevent a latent strabismus from becoming a manifest one. (6 references)

John J. Stern.

Toselli, C. **Mechanism of the dissociated vertical deviations.** Boll. d'ocul. **32**:305-310, May, 1953.

Discussing the theories proposed to explain the alternating hyperphorias, Toselli refutes the pathogenetic influence of the vestibular apparatus. In his studies, stimulation of the labyrinth by cold or warm water and by 90 degrees inclination of the head never produced what could be called alternating hyperphoria. (references) K. W. Ascher.

Toselli, C. **Paralysis of divergence associated with paresis of an inferior oblique.** Boll. d'ocul., **32**:401-412, July, 1953.

This rare and diagnostically difficult case was that of a 64-year-old woman who had had headache and diplopia for four years before admission. Urine and blood serologic findings were normal; blood pressure was 170/95. Close objects did not seem double. With correction of her myopic error of 13 diopters, the patient had normal visual acuity. The Maddox test at six meters revealed homonymous diplopia of 12 prism diopters distance, in all directions of gaze except when looking down, where the double images moved closer together. Between 30 and 18 cm. no diplopia was found; at fixation nearer than 18 cm. crossed diplopia ensued. Synoptophore study revealed esotropia five degrees, fusion amplitude

in convergence 29Δ, divergence zero for near and for distant vision. On the Maddox cross a paresis of the right inferior oblique muscle was found. No improvement could be achieved by orthoptic treatment. The author concludes that divergence is not merely relaxation of convergence; active divergence and a center for it must be assumed. (57 references)

K. W. Ascher.

Toselli, C. **The position of absolute rest of the eye under the effect of curare.** Boll. d'ocul. **32**:333-340, June, 1953.

The rest position of the sleeping person, of the person under deep general anesthesia, and of the corpse is equivalent in type and in degree to the relaxation obtained during the action of curare. The observations were performed on orthophoric patients, between 6 and 50 years of age, and subjected to major surgery under different types of curare, applied at about 0.20 mg. per kg. (comprehensive bibliography) K. W. Ascher.

Wiedersheim, O. **Nystagmus as a sign of centrally disturbed coordination.** Arch. f. Ophth. **153**:510-519, 1953.

The author presents the theory of nystagmus as a disturbance of processes which govern the normal ocular motility such as postural tonus, coordination, and reflex and intentional ocular movements. Their disturbance produces either pendular or railroad nystagmus or disrupts the coordination of the paired visual organ. Ernst Schmerl.

## 7

## CONJUNCTIVA, CORNEA, SCLERA

Alajmo, A. **An uncommon form of corneal degeneration.** Rassegna ital. d'ottal. **22**:26-35, Jan.-Feb., 1953.

Alajmo describes an uncommon and not previously reported form of corneal degeneration in a healthy 39-year-old man. The lesion was bilateral and there were no other pathologic changes in the eye. The biomicroscope showed a degeneration with oily spheres, like that described by Lugli, but one which differs in that the lesion was central and there were no senile degenerative changes. The spots composing the lesion were yellow and situated beneath the corneal epithelium. The author proposes the name "primary oleoguttate central superficial degeneration of the cornea." (1 colored plate)

Eugene M. Blake.

Amies, C., Murray, N. L., Scott, J. G., and Warren, R. St. H. **Trachoma in the South African Bantu: A survey in Sekukuniland.** Rev. internat. du trachome **30**:405-410, 1953.

Photographs of inclusion bodies are presented to prove that trachoma exists amongst the South African Bantu. Trachoma was found in 94 percent of the children in two villages near the Jane Furse Memorial Hospital in Sekukuniland. Of the 503 children examined, 68 had normal lids. When 47 of these were examined with the loupe, however, 38 were found to have pannus. This indicates that trachoma frequently heals without scarring, but leaves diagnostic blood vessels in the cornea. John C. Locke.

Beasley, H., and Shields, T. L. **Ocular pemphigus.** Texas State J. Med. **49**:709-711, Sept., 1953.

Ocular pemphigus, which is really a pemphigoid reaction and different pathologically and clinically from true pemphigus, is a rare disease. It starts as a mild conjunctivitis; later small white bands may be seen under the conjunctiva. Ankyloblepharon results from the fibrosis, causing ptosis and symblepharon. The upper and lower canthi next unite to shorten the horizontal fissure. The cornea becomes opaque by drying and there is trichiasis and pannus formation. Pain is

severe. The process ends in blindness. Treatment is palliative, except early in the process, when ACTH and cortisone are of value. (6 references)

Irwin E. Gaynon.

Boudet, Ch. **On the mechanism of vascularization of corneal grafts after post-inflammatory leucomas.** Arch. d'opht. **13**:374-383, April, 1953.

In a biomicroscopic study of 16 cases of penetrating corneal grafts for the relief of leucoma, the author noted the constancy of new-vessel formation in the deeper layers of the graft as opposed to the almost complete absence of all superficial vascularization. He explains this phenomenon on the basis of the constant corneal edema in the immediate post-operative phase which facilitates penetration of vessels into the stroma. Each case is fully described with drawings of the neovascularization involved. (17 figures) Phillips Thygeson.

Cousineau, G. G., and Lloyd, L. A. **Preliminary report on prophylaxis of ophthalmia neonatorum.** Tr. Canad. Ophth. Soc. **5**:75-80, 1952.

A group of 1,703 newborn infants received Sulmefrin at birth; a second group of 1,127 sodium sulphacetimide ointment; a third group of 1,175 1-percent silver nitrate; and a fourth group of 640 infants received, alternate babies, 1 percent silver nitrate and 10 percent sodium sulphacetimide. In the entire series of 4,326 babies there were only three cases of gonorrheal ophthalmia. Modern methods of prenatal care are probably more important than any prophylactic preparation in decreasing this incidence. Inclusion conjunctivitis occurred in 7 percent of infected eyes from the group treated with the sulfa preparation, but in only 1 percent of infected eyes in the group treated with silver nitrate. The incidence of chemical reactions with silver nitrate exceeds the incidence of conjunctival infection, while with sulfa preparations chemical reactions are negligible. (4 tables, 6 references) John V. V. Nicholls.

Cuppers, C., and Krucke, W. **Involvement of the eye in paramyeloidosis.** Klin. Monatsbl. f. Augenh. **123**:144-157, 1953.

The authors present a patient with a recurrent amyloid tumor of the conjunctiva. The gamma globulins were increased in the serum and the X-ray examination of the skull suggested a generalized plasmocytoma. Localized amyloid tumors may therefore be only a part of a widespread disease. In two cases of generalized paramyeloidosis the authors found disturbances of ocular motility and of pupillary movements. Histologic examination revealed deposition of amyloid in the vessels, nerves and extraocular muscles. (11 figures, 23 references)

Frederick C. Blodi.

Daily, L., Jr., and Daily, R. K. **Present status of corneal transplantation.** Texas State J. Med. **49**:706-708, Sept., 1953.

Corneal transplantation is indicated in keratoconus, all corneal dystrophies except epithelial and endothelial dystrophy of Fuchs, scar of the central portion of the cornea, and nebulae and vascularization of luetic interstitial keratitis. The authors use a partial penetratory corneal transplantation technique which includes the use of miosis, curare, egg-membrane over the corneal sutures, and topical application of cortisone. This procedure obviates the usual complications of glaucoma, iris adhesions, delayed reformation of the anterior chamber, iritis, invasion by bloodvessels and edema with opacification, due to an allergic reaction between donor and host cornea. (2 figures, 8 references) Irwin E. Gaynon.

Di Ferdinando, R. **Disciform keratitis and acute retrobulbar neuritis.** Rassegna ital. d'ottal. **22**:199-206, March-April, 1953.

A 30-year-old, apparently healthy woman developed a keratitis of the left eye of endogenous origin. Shortly afterwards, a partial paralysis of the levator of the upper lid developed which was associated with an acute retrobulbar neuritis. The cause was considered to be the virus of herpes simplex, without the support of laboratory findings. After recovery the vision was 1/20 normal, with temporal palor of the disc. Eugene M. Blake.

Elste, E. R. **Fundamentals on the etiology of trachoma.** Rev. internat. du Trachome **30**:395-404, 1953.

The author sets forth the hypothesis that trachoma is a local chemical intoxication caused by lipides, arising from conidia and chlamydospores of a specific fungus. He takes his reasoning from geographic, climatic, and epidemiological considerations and also from the study of certain properties of fungi and their spores. He stresses that the condition is not directly due to the fungus growing on the conjunctiva, but rather to a chemical action arising from it, and sensitizing the mucous membrane to secondary infections. John C. Locke.

Friede, R. **Keratoplasty for limbal dermoids.** Klin. Monatsbl. f. Augenh. **123**: 223-225, 1953.

A partial, lamellar keratoplasty was done after the excision of the dermoid. The cosmetic result should be better than after simple excision where a corneal scar with pseudopterygium may develop. (4 figures) Frederick C. Blodi.

Mueller, Fritz. **Reticulate corneal dystrophy.** Arch. f. Ophth. **153**:407-424, 1953.

Three pedigrees of reticulate corneal dystrophy with 21 affected persons are described. The clinical picture is about the same as it is known from older studies. However, in the one group of six persons two lacked the characteristic reticulum while other signs of dystrophy were present. It seems doubtful whether the grouping of the hereditary dystrophies into several subdivisions is justified.

Ernst Schmerl.

Garzino, Alessandro. **Large post-traumatic cysts of the sclera.** Rassegna d'ottal. **22**:308-317, May-June, 1953.

Scleral cysts arise from lack of continuity of the sclera with incarceration of bits of epithelium from the conjunctiva or cornea. The degeneration of the central cells in the growing mass causes distentions of the outer wall. The character of the fluid varies from case to case. The author's patient was a 14-year-old-boy who had a scleral rupture nine months before the eye was enucleated. The cyst reached large proportions. The pathologic changes are described and illustrated. (8 figures, 22 references) Eugene M. Blake.

Gonzales Vanrell, Francisco. **Primary epithelioma of the conjunctiva and cornea.** Arch. Soc. oftal. hispano-am. **13**:479-501, May, 1953.

Three cases are reported, and the literature is reviewed. One tumor was a spino-cellular epithelioma, with large cells of infiltrating character. The patient, a man 48 years old, had leukemia but the author felt that, because of the leukemia, excision of the tumor and galvanocauterization of its base was all that was indicated, in spite of the fact that the histological examination of the tumor demonstrated a tendency to infiltrate and there was the probability of recurrence. In the second case a superficial basal cell epithelioma occurred in a man, 71 years old. The tumor was removed and the base curetted and cauterized. There was no recurrence over a period of years. In the third case a spino-cellular epithelioma was surrounded by a dense lymphocytic reactive infiltration, in a man 56 years of age. This tumor was intimately connected

with the cornea, and was separated easily from the sclera. It was removed and the base cauterized. In the comprehensive review of the literature, reference is made to the study of Ash, Campbel and Wilder and their conclusions are quoted in full. Brief reference is made to the various therapeutic procedures employed by various authors, and Gonzalez concludes that excision followed by wide cauterization of the base is adequate. (7 figures, 55 references) Ray K. Daily.

Jimenez Munoz, Ramon. **Suppurating anterior periscleritis.** Arch. Soc. oftal. hispano-am. **13**:525-530, May, 1953.

The literature is reviewed, and a case reported. The patient was a man, 28 years old, who recovered completely after incision of the abscess. Abscesses in the anterior portion of the sclera are less prone to complications than those in the posterior portion. Treatment consists of hot applications or diathermy locally, foreign protein therapy and antibiotics and, when the abscess becomes visible, incision with removal of the core. (2 figures)

Ray K. Daily.

Grawitz, P. B. **The experimental regression of a conjunctivitis.** Klin. Monatsbl. f. Augenh. **123**:184-189, 1953.

The cells of a conjunctival smear are designated as A and B if they resemble epithelial cells. They are called C and D the closer they resemble leucocytes (the author assumes that the latter derive from the epithelial cells). During a conjunctivitis types C and D increase relatively. The regression of an inflammation can be followed by the reappearance of types A and B. In animal experiments privin caused regression of a conjunctivitis, while cocaine and adrenaline did not influence the experimental inflammation. (1 figure, 6 tables, 5 references)

Frederick C. Blodi.

Gualdi, G. **Autoplasm in the treatment of conjunctival injury.** Rassegna ital. d'ottal. **22**:176-183, March-April, 1953.

The author gives an excellent description of the coagulation of blood and of the chemistry of the plasma. There is also a review of the investigations of other workers in the same field. The experimental work consisted in producing tears in the conjunctiva of six rabbits and treating one eye of each with blood plasma, and in suturing the wounds in the opposite eye. The plasma treated wounds healed more rapidly and with less marked reaction. Eugene M. Blake.

Lyons, Maxwell F. **The two-fold problem of acute conjunctivitis and trachoma in Egypt: A survey of the epidemiology and of recent experiments on their prophylaxis.** Rev. internat. du trachome. **30**:341-351, 1953.

The author points out that gonococcal conjunctivitis of the new-born is almost unknown in Egypt, and yet almost all children of the poorer classes have infections of the conjunctiva by the age of six months, usually by the Koch-Weeks bacillus or the gonococcus. Treatment of established cases in the hospitals has little effect on the regular cycle of epidemics in the villages. The prevention of these bacterial infections is the most effective preventive against trachoma. The two principal etiological factors in epidemics of conjunctivitis are the human carriers and flies. Contamination is less frequent from mother to child, than from child to child.

John C. Locke.

Magni, S., and Zaffagnini, E. **Radiation treatment of vascularization in corneal transplants.** Rassegna ital. d'ottal. **22**:269-285, May-June, 1953.

Corneal vascularization in general, and that of the limbus in particular, is an expression of a disturbed nutrition. The

problem is not only a mechanical one but also a biological one. The treatment is one not only of destruction of new-formed vessels but also of re-establishment of trophic changes. Radiation treatment in proper dosage can cause vascularization to disappear except in cases of long standing, and prevents new formation of vessels. There appears to be little choice between the use of beta rays and X rays. (7 references) Eugene M. Blake.

Rizzini, V. **Pigmented tumors of the conjunctiva.** Rassegna ital. d'ottal. **22**:139-156, March-April, 1953.

The author would group all the melanotic growths of the conjunctiva, such as nevocarcinoma, melanosarcoma, chromatoforms and melanoma under the name of neuro-ectoderma. The case reported concerned a young woman who presented a brownish growth of the right eye at the limbus. There was considerable conjunctival reaction with dilated veins. The slit-lamp showed fine pigmented areas surrounding the main growth and dispersion of pigment on Descemet's membrane. Histologically the tumor involved the ciliary body and iris and extended into the vitreous. (5 figures) Eugene M. Blake

Seale, E. R. **Carcinoma of limbus.** A.M.A. Arch. Dermat. & Syph. **68**:286-295, Sept., 1953.

Nineteen patients with carcinoma of the limbus, treated with radium, are reported. The results obtained from the use of beta rays were satisfactory in three patients, but because these rays caused a rather intense post-operative reaction, gamma radiation was substituted in the sixteen others. Some degree of post-therapeutic lens damage was noted in six patients. Lenses containing incipient cataracts are more susceptible to radium than are normal ones. Of the four patients in whom mature cataracts developed, three had incipient cataracts before therapy. (2 figures, 33 references)

Irwin E. Gaynon.

Sédan, Jean. **The evolution of the international problem of trachomatous travellers and emigrants.** Rev. internat. du trachome **30**:352-360, 1953.

The author explains the recent change of opinion (since 1949) of the trachomaologists concerning international rules on trachomatous emigration. After a very severe period, forbidding any travel from country to country for those with active trachoma, a more liberal point of view appears, which is included in the Reports of the Commission of Experts of the W.H.O. (Geneva, 1952). This report advises against limiting travel for subjects with trachoma IV and even considers the emigration of those with florid trachoma, provided that the countries taking them in can give effective treatment. These changes are linked to the radical lessening of the problem of the infectiousness of trachoma, due to the introduction of general sulfonamide and local antibiotic therapy. John C. Locke.

Tsutsui, Jun. **Studies on the immunity caused by repeated infections with trachoma.** Rev. internat. du trachome **30**:329-340, 1953.

As it seemed to the author that it was due to immunity that the existence of the virus could not be demonstrated in most cases of chronic trachoma, he has attempted to study the intimate mechanism of such immunity by a single series of successive inoculations of his own eyes. From inoculations repeated at intervals of from two to six months, the infection took place twice in the right eye, and once in the left eye. A fourth inoculation did not immediately produce a new infection in the right eye. However, after a month, a mild acute trachoma occurred, which

became better spontaneously in a month. Gradually, as the infection recurred, the number of inclusion bodies decreased, even to their complete disappearance. Because the fourth inoculation did not produce an infection, the author infers the presence in his serum of antibodies capable of temporarily attenuating the symptoms of trachoma and of causing the inclusion bodies to disappear, also temporarily. He is unable to draw any conclusions as to its therapeutic value. In trachomatous immunity, local immunity seems predominant, but a general immunity is also possible. It seems feasible to believe that the disappearance of the trachoma virus in chronic trachoma is an effect of immunity. John C. Locke.

Wachendorff. **Removal of a rust ring after a corneal foreign body.** Klin. Monatsbl. f. Augenh. **123**:228, 1953.

The author advises the use of an electric dental drill. Frederick C. Blodi.

## 8

### UVEA, SYMPATHETIC DISEASE, AQUEOUS

Damel, Carlos. **Pathology of Bruch's membrane.** Arch. oftal. Buenos Aires **38**:150-165, April, 1953.

The author describes the various disease processes of Bruch's membrane in the light of his own findings and those reported in the literature. He affirms that the various exudative and hemorrhagic processes between the pigment epithelium and Bruch's membrane originate from a common type of reaction which consists of the new formation of connective tissue when the injury starts in the elastic layer and this is perforated.

Joseph I. Pascal.

Halbertsma, K. T. A. **Coloboma of the choroid and of the disc, complicated by macular changes.** Ophthalmologica **124**: 293-296, Nov., 1952.

A 47-year-old woman complained of recent diminution of the vision in her left eye. Examination revealed a partial coloboma of the choroid below, a crater-like depression of the temporal quadrant of the disc and, in the macular region, a cystlike anomaly, possibly a symptom of chorioretinitis. The vision that was first reduced to 6/25, gradually improved to 6/15. The macular lesions became less cystlike and more pigmented. The congenital anomaly may have predisposed the eye to a vascular disturbance. (1 figure, 12 references) Peter C. Kronfeld.

Huerkamp, B. **Recurrent hypopyon with erythema exudativum multiforme after perforating injury.** Klin. Monatsbl. f. Augenh. **123**:129-132, 1953.

A 26-year-old man received a perforating injury to the left eye and a piece of steel was extracted with the magnet. After this injury he had numerous attacks of hypopyon which lasted from one to four days. During these attacks an erythema of the skin developed, but the mucous membranes were never involved. Culture of the hypopyon was negative. The relationship to Behcet's syndrome is discussed. The author believes that the injury was only the trigger mechanism precipitating the syndrome. (9 references)

Frederick C. Blodi.

Leydhecker, W. **An isolated piece of iris in the anterior chamber for 11 years.** Klin. Monatsbl. f. Augenh. **123**:229-230, 1953.

After a cataract extraction 11 years ago, a piece of iris remained lying on the peripheral part of the iris. It did not change in color or structure though it was not vascularized. Nutrition must have come from the aqueous. (2 figures)

Frederick C. Blodi.

Manzitti, E. **Chronic uveitis.** Arch. oftal. Buenos Aires **28**:1-22, Jan., 1953.

A detailed account of the etiology, di-

agnosis and treatment of the different forms of uveitis is presented. Very many illustrative cases are fully described.

Joseph I. Pascal.

Matteucci, P. **Early symptoms of total uveitis.** Rassegna ital. d'ottal. **22**:233-239, May-June, 1953.

In chronic iridocyclitis, the qualitative examination of the macula can demonstrate the existence of a choroiditis and of macular edema in early cases. The presence of metamorphopsia in such cases is decisive evidence of macular damage, even when campimetric examination leaves doubt of the diagnosis. The usual changes of anterior uveitis are revealed by biomicroscopic study. Eight cases are reported to demonstrate the picture of extensive uveitis. (3 figures, 14 references)

Eugene M. Blake.

Politzer, G. **The origin of spontaneous epithelial cysts of the iris.** Arch. f. Ophth. **153**:497-503, 1953.

The author found in the four eyes of two human embryos of the second month a bulging and formation of small spheres near the margin of the eye cup. Spheres and eye cup were connected by a narrow band. The origin of iris cysts from these spheres is discussed as are the formative and regenerative forces of the iris in man and animals.

Ernst Schmerl.

Remky, H. **Severe forms of uveoencephalitis.** Klin. Monatsbl. f. Augenh. **123**:166-180, 1953.

A 50-year-old woman developed a severe bilateral uveitis with meningeal symptoms, somnolence and dysacusia. After seven weeks the vitreous opacities cleared and papilledema with bilateral retinal detachment could be seen. The retina became reattached and depigmented. A second attack of anterior uveitis followed. Vision remained practically nil. This was certainly a case of Harada's disease. Aqueous and cerebro-spinal fluid were injected into the vitreous of rabbits. A serous chorio-retinitis followed. If the material was injected into the anterior chamber of rabbits an anterior uveitis followed. No pathogenic organism could be found. (4 figures, 84 references)

Frederick C. Blodi.

Teulières, J. **The ophthalmia due to caterpillars.** Arch. d'opht. **13**:391-396, April, 1953.

The author notes that while ophthalmia due to caterpillar hairs is rare, its gravity is such as to warrant special attention. He mentions that the caterpillars of pine trees, Thaumatopea pytiocampa, are extremely numerous in the regions of Landes and Gironde during the months of February and March and that these insects possess venin glands on their dorsal areas. The venin alone, or more often the hairs contaminated with venin, produce the ocular injuries. Four cases are reported; one was due to venin from a crushed insect and was relatively mild, but the other three were severe with one of them requiring enucleation. Teulières concludes that ophthalmia due to caterpillars is a definite clinical and etiologic entity characterized by pain of great intensity from onset and by severe conjunctival and corneal changes due to penetration of the hairs, and that it is complicated by iridocyclitis and often by alterations in the ocular tension. He concludes further that the well-defined anatomopathologic picture is one of inflammatory nodule formation. If venin alone is causal, the lesions are milder and more superficial. (12 figures)

Phillips Thygeson.

Vannini, Angelo. **Anterior chamber cysts in eyes operated upon by iridencleisis.** Rassegna ital. d'ottal. **22**:240-244, May-June, 1953.

Cysts and pseudo-cysts of diverse forms, nature and seat may be seen in the

anterior chamber. Gandolfi says that a moving formation, free in the anterior chamber, which histologically represents pigment of the iris remains suspended and undergoes a lipoid transformation after cataract operation. François saw a small serous cyst in the ciliary processes gonioscopically. The writers describe a case in which there were two cysts, seen with the gonioscope, after an iridencleisis operation. While such free cysts are usually located in the lower angle they may well have arisen above at the site of the incision and dropped. Eugene M. Blake.

## 9

### GLAUCOMA AND OCULAR TENSION

Auricchio, Giacinto. **The mechanism of action of some antiglaucomatous operations through studies of biochemical modifications induced by them.** Ann. di ottal. e clin. ocul. **79**:259-274, May, 1953.

In an attempt to clarify the question whether antiglaucomatous operations achieve a reduction of tension by reducing production of aqueous or facilitating its outflow, the author estimated the concentration of lactic acid and pyruvic acid in the vitreous and aqueous of rabbit eyes which had previously undergone an iridectomy, a cyclodiathermy or an iridencleisis. At the same time the serum concentrations of the same metabolic products of glucose were measured. Iridectomy causes a very slight fall of lactic and pyruvic acid levels in both aqueous and vitreous for a short period only. Iridencleisis and cyclodiathermy are followed by a marked decrease of the level of both substances, maintained six months after the intervention. No accumulation of the metabolites of lens or retina was observed in any animal, which proves that no retention of intraocular fluids takes place under these experimental conditions, and that the results are not masked or compensated by collateral phenomena, e.g., increased outflows, and increased permeability of the uveal vessels. (62 references)

John J. Stern.

Carballo, F., and Hick, J. **Preglaucoma.** Arch. oftal. Buenos Aires **28**:32-33, Jan., 1953.

The classic texts of Duke-Elder, Malbran and Vidal have called attention to the various premonitory symptoms of incipient glaucoma. These are rapid increase of presbyopia, headaches, transient obscuration of vision, a feeling of ocular fullness, slight pain in the eyes after having been in the dark or after other vasomotor stimuli. To these may be added migraine, photophobia, retinal asthenopia and heightened dynamic ophthalmotonus. In the two cases reported here, the interesting fact is that the symptom of obscuration of vision in the dark, especially at the cinema, was the most outstanding early symptom and confirms the importance of this test. Joseph I. Pascal.

Cristini, G., and Pagliarani, N. **Clinical exploration of uveal circulation with reference to prognosis in primary glaucoma.** Arch. oftal. Buenos Aires **38**:145-149, April, 1953.

The effect on ocular tension of the amyl nitrate test in primary glaucoma was studied on 50 eyes in basal conditions, after the instillation of cholinergic drugs, and after unilateral alcohol-novocain block of the stellate ganglion. In general, a fall of ocular tension was observed, more marked in early cases and when the initial tension was high. In the more advanced cases the fall was low or even lacking, and similarly after instillation of cholinergic drugs. In congestive glaucoma and after block of the stellate ganglion greater variations in the rise of tension were frequent. Decrease of ocular tension is interpreted in relation to the reserve capillary bed in the uvea, which shows its

effect according to the stage and severity of the glaucoma. Joseph I. Pascal.

Kutscher, Eberhard. **Reflex changes of the intraocular pressure in primary glaucoma produced by massage of certain zones of the skin.** Arch. f. Ophth. **153**:488-496, 1953.

Several cases of primary glaucoma are described in which the ocular tension could be lowered by massage of certain reflex areas. The areas showed the following localization: 1. Near the cervical vertebral column ($C_5$ to $C_8$), 2. near the thoracic vertebral column ($D_3$-$D_5$), 3. near the lumbar vertebral column ($D_9$-$D_{12}$ and $L_4$-$L_5$), and 4. near the sternum ($C_4$, $D_2$-$D_4$). The author calls attention to Head's studies dealing with the disturbances of the sensitivity of the skin in internal diseases. One might similarly postulate a connection between disturbances of the ocular tension and the sensitivity of the skin. Ernst Schmerl.

Morpurgo, Fabio. **The pathogenesis of glaucoma.** Ann. di ottal e clin. ocul. **79**: 377-394, July, 1953.

The darkroom provocative test in normal subjects causes a slight increase of the pressure in the retinal capillaries; in glaucomatous patients it results frequently in a more pronounced increase. Acute congestive glaucoma consists of vascular instability which manifests itself in acute arterial and capillary vasodilation with increased production of aqueous. A second factor must come into play, however, consisting of a resistance to the outflow of aqueous which in turn is caused by edema in the ciliary body and blockage of the chamber angle. The essential difference between chronic simple glaucoma and acute glaucoma is that in chronic glaucoma the decreased outflow and the increased capillary pressure remain elevated even if the ocular tension becomes normal, whereas in acute glaucoma both factors return to normal with return of normal tension. (116 references) John J. Stern.

Rinaldi, G. **Combined provocative tests in glaucomatous eyes after surgery.** Boll. d'ocul. **32**:357-377, June, 1953.

The tests of Bloomfield and Lambert were combined with a modification of Sugar's test; in eight of twelve glaucomatous eyes the Bloomfield-Lambert test gave negative results while the combination of both tests gave positive results in all twelve eyes. Negative results were obtained in thirty glaucomatous eyes after successful surgery; in nine eyes with absolute glaucoma the test was positive. D.F.P. changed positive results to negative ones. Seventeen eyes of twelve patients were studied one year and longer after surgery was performed; four out of ten eyes after successful surgery for simple chronic glaucoma gave positive tests. Out of five eyes, successfully operated on for congestive glaucoma, only one gave a positive test. The results are discussed and abbreviated case histories of twelve patients are presented. (1 table, references) K. W. Ascher.

Sbordone, Girolamo. **Study of corneal spaces in glaucomatous eyes.** Rassegna ital. d'ottal. **22**:262-268, May-June, 1953.

Sbordone measured the corneal spaces in glaucomatous eyes with the apparatus of Maurice and Giardini mounted upon a Goldman slitlamp. In acute "irritative" glaucoma, the spaces were increased in size, while in the chronic and simple form they were diminished. The variations in measurement of 26 patients are given and the possible causes of the changes are discussed. Eugene M. Blake.

Swan, K. C. **Miotic therapy of chronic glaucoma-changing trends.** Tr. Canad. Ophth. Soc. **5**:34-50, 1952.

Dibenamine acts by relaxing the pu-

pillary dilator muscle. The drug must be given systemically. Its action is not related to either miosis or to change in systemic arteriolar pressure, but to decreased formation of fluid by the ciliary body. Dibenamine has little effect on the ocular tension of the normal eye but may cause a dramatic fall in tension in cases of acute glaucoma. This effect cannot be maintained for more than a few days. The clinical use of the drug is limited to emergency control of acute glaucoma in hospitalized patients.

Acetylcholine, carbamylcholine, pilocarpine, and mecholyl act directly on the sphincter muscle of the iris, and on accommodation. The action of pilocarpine is insidious and causes no discomfort. As it wears off there is a period of diminished muscle tone. Pilocarpine has little effect on the composition of the ocular fluids. The nitrate is stable and not irritating. In a ½- to 1-percent solution of buffered methyl cellulose consistent absorption is obtained. Carbamylcholine is more potent, and acts longer, than pilocarpine. Carbamylcholine is highly water-soluble and must be dispensed in a water-free base. It is a valuable drug to have in reserve for the treatment of advanced chronic glaucoma. Physostigmine and diisopropy fluorophosphate (D.F.P.) act by preventing the breakdown of acetylcholine. The action is abrupt and violent. These drugs cause spasms of the sphincter muscle, the ciliary muscles and the orbicularis. In aphakia these effects are less noticeable than when the lens is present. They both are unstable in water and should be prescribed in an anhydrous base. Physostigmine is of little use in chronic glaucoma, but D.F.P. is of great use in chronic glaucoma in aphakic patients.

Combinations of miotic drugs are not always additive in their effects. Mecholyl and prostigmine produce a true synergism. However, pilocarpine and physostigmine both protect against the violent action of D.F.P. Also combinations of pilocarpine and physostigmine have less effect than when physostigmine is used alone. Pilocarpine is clinically useful to dampen the severe effect of D.F.P., while D.F.P. can be used in combination with pilocarpine to fortify the effect of the latter drug.

Synechiae at the angle of the anterior chamber may develop in chronic glaucoma, in glaucoma following iritis, in glaucoma following cataract extraction, and in certain cases of chronic glaucoma with narrow angles. Periodically it is wise to produce maximum miosis in these patients, either by D.F.P. or by iontophoresis of mecholyl. This treatment will break the synechiae and reopen the angle. Then continued treatment with a weaker miotic will be effective.

Loss of visual field, the formation of peripheral anterior synechiae, progressive enlargement of the lens with encroachment of the angle of the anterior chamber, alterations in the optic disc, and occlusion of a retinal vein crossing a glaucomatous cup all indicate advancement of the glaucoma. Change in the visual fields during dark adaptation is a sensitive index of the advancement of glaucoma.

Tonometric measurements should be made so that examples of the ocular tension during all parts of the day and night are available. These may be obtained over several days, rather than during one continuous day. Any rise in tension during a particular part of the day can then be controlled by miotic therapy. Also any tendency to sudden rises in tension may be indicated, and can be studied further by provocative tests.

Two frequent causes for unsuccessful medical treatment of glaucoma are 1. inadequate or improper prescription of miotics, and 2. the patient's lack of understanding and appreciation of the objective and of the details he must carry out. **(4 figures, 6 references)**

John V. V. Nicholls.

Urrets-Zavalia, A. **The mode of action of the cyclodiathermy operation.** Ophthalmologica **124**:257-270, Nov., 1952.

An ardent advocate of the retrocilliary, non-penetrating diathermy (cfr. Am. J. Ophth. 36:203, 1953) Urrets-Zavalia analyzes the clinical and pathologic evidence upon which the existing views concerning the mode of action of the cyclodiathermy operations are based. He arrives at the conclusion that the most likely mechanism of the lowering of the ocular tension is a reduction in the secretory activity of the ciliary body, that is, a reduction in rate of transfer of the osmotically effective electrolytes into the aqueous. (56 references)

Peter C. Kronfeld.

Vannini, A. **Gonioscopy in ocular trauma.** Rassegna ital. d'ottal. **22**:25-138, March-April, 1953.

Vannini urges the use of the gonioscope in all injuries of the eyes, whether contusive or perforating. Direct observation of the angle may reveal hemorrhage, foreign body, iridodialysis and other lesions. Interesting cases are reported illustrating the value of the procedure. (10 figures)

Eugene M. Blake.

Weinstein, P., and Forgacs, J. **Venous pressure and ocular tension.** Brit. J. Ophth. **37**:444-446, July, 1953.

An association between changes in general blood pressure and ocular tension is generally doubted because ocular tension usually is higher in the morning when blood pressure is usually lower. In this study a definite correlation between the venous pressure in the cubital vein and ocular tension was found. It has previously been established that variations in pressure within the aqueous veins result in similar variations in ocular tension. A definite correlation between the diurnal variations of pressure in the episcleral aqueous veins and in the cubital veins was found in this study.

Morris Kaplan.

## 10

### CRYSTALLINE LENS

Allen, T. D., and Pushkin, E. A. **Rose thorn penetrating the cornea into anterior chamber.** Illinois M. J. **104**:6-8, July, 1953.

A transient posterior rosette cataract formed after a rose thorn had penetrated the cornea. The thorn was removed surgically. Cortisone was not of great value. It is probable that the local lenticular proteolytic changes resulting from the trauma are due to imbibition of the locally existing interstitial fluid rather than the action of aqueous through a rent in the capsule.

Irwin E. Gaynon.

Auricchio, G. **Cataract complicating glaucoma.** Rassegna ital. d'ottal. **22**:50, Jan.-Feb., 1953.

This not uncommon problem is discussed under three headings: 1. cataract complicated by glaucoma; 2. glaucoma, which is the consequence of cataract, and, 3. cataract and glaucoma co-existing, but independent in origin. Auricchio emphasizes the presence of pigment on the lens capsule in chronic simple glaucoma, lenticular edema occurring in acute glaucoma, subepithelial cataract developing in acute glaucoma, capsular glaucoma, increase of cataract after the development of glaucoma, and the growth of incipient cataract which existed before the glaucoma and increased rapidly after surgery for glaucoma.

Eugene M. Blake.

Hill, K. R., and Goodwin, G. P. **Influence of hypotension on the intracapsular cataract operation.** Brit. J. Ophth **36**:683-688, Dec., 1952.

A series of patients was studied in whom cataract had been extracted intracapsularly under general anesthesia. The blood and intraocular pressures were lowered either by posture alone or with the addition of hexamethonium bromide to

facilitate operating conditions. In the older patients, posture alone usually produced the low intraocular pressure required. In the younger age groups hexamethonium bromide was required in addition. Surgical complications during operation were negligible as a result of the low preliminary intraocular pressure and the absence of bleeding.

Orwyn H. Ellis.

Hubbersty, F. S., and Gourlay, J. A. **Secondary glaucoma due to spontaneous rupture of the lens capsule.** Brit. J. Ophth. **37**:432-435, July, 1953.

Rarely spontaneous cure of cataract by rupture of its capsule does occur and unfortunately most are followed by secondary glaucoma. Within two years the authors saw four such cases. Some of the patients had an acutely sick eye, the anterior chamber was flooded with grayish lens material very much as in a purulent endophthalmitis; others had a very chronic and insidious disturbance with no warning of what was occurring. The glaucoma which may be fulminating is due much more to the chemical irritation of the toxic products of lens hydrolysis than to mechanical obstruction of the chamber angle. In one eye in which gonioscopy was successful the trabecular spaces were seen to be wide open. Even though the eye be acutely inflamed, removal of the lens material is indicated.

Morris Kaplan.

Patel, V. P. **The Ridley intra-ocular acrylic lens.** Brit. J. Ophth. **37**:423, July, 1953.

The principal objection to the Ridley technique is the long-standing iritis resulting from the manipulation of the iris during the implanting of the acrylic lens. A modification of the original procedure is described which, it is believed, will make the procedure popular with ophthalmic surgeons. The change in technique does away with the lifting of the iris by the iris hook and substituting the force of a jet of saline from a fine cannula for irrigation of the lacrimal sac. This is best done after one of the corneal sutures has already been tied. Morris Kaplan.

Wettler, H. **A case of Werner's syndrome.** Ophthalmologica **124**:279-286, Nov., 1952.

A typical case of Werner's syndrome is described in detail. (See Am. J. Ophth. 32:1032, 1949, and 35:161, 1952.) (3 figures, 29 references)

Peter C. Kronfeld.

## 11

### RETINA AND VITREOUS

Alajmo, A., and Aurricchio, G. **Experimental detachment of the retina.** Rassegna ital. d'ottal. **22**:192-198, March-April, 1953.

Various methods have been employed in an attempt to produce detachment of the retina in experimental animals since 1875. Among these methods were those in which one endeavored to produce an exudative choroiditis with chemical irritants, those in which chemical substances or foreign bodies were introduced to produce traction on the retina, aspiration of the vitreous, and mechanical detachment of the retina.

The authors succeeded in producing retinal separation in the eyes of rabbits. They first produced a tear in the retina and then injected a solution of hyaluronidase into the vitreous. As a rule, the detachments persisted, and various phases of the process strongly resembled the detachments in man. The authors suggest that hyaluronidase may play a part in idiopathic detachments.

Eugene M. Blake.

Appelmans, P. J. M., and Carrier, E. **Alterations of the vitreous body associ-**

**ated with iridocyclitis.** Bull. Acad. roy. de med. de Belgique **18**:270-279, 1953.

The authors have observed, clinically, a gradation in alterations of the vitreous body, associated with iridocyclitis. The most trivial change is characterized by a Tyndall effect in the liquid vitreous and by the presence of fine granules adherent to the vitreous framework. These changes take place in the anterior third of the vitreous. If the alterations are more marked, there are pigment granules, swelling of the fibrils, cottony tufts, nodules of varying size, and branching fibrinous filaments. In the extreme cases there are optically empty holes or cavities, caused by vitreous liquefaction. The hyaloid is refractory to these changes. Between the cavities are filiform or membranous tracts which by retraction are capable of pulling on the retina or ciliary body. Pure iritis does not disturb the vitreous. It is the cyclitis which affects it by contiguity. The changes noted suggest a complex fibrillary structure for the vitreous, rather than that of a homogeneous gel.

John C. Locke.

Babel, J. **Diabetic cataract produced by alloxan.** Arch. f. Ophth. **153**:520-552, 1953.

The author administered alloxan to rabbits and rats and produced diabetic conditions with and without formation of cataracts. During the acute stage he found the hyperglycemia combined with a hyperlipemia and hypoproteinemia. The lipids could also be demonstrated in the aqueous. Small subcapsular vacuoles presented the first sign of an affection of the lens, usually 12 to 20 days from the beginning of the experiments. Somewhat later a posterior cortical cataract formed. However, the cortex never became completely cataractous, nor did the nucleus of the lens become involved. Retinal changes were not observed. With a normalization of the bloodsugar the subcapsular vacuoles usually disappeared. The experimentally produced forms of cataract seemed to be comparable to certain types of cataract in man. Ernst Schmerl.

Bembridge, B. A., and Houlton, A. C. L. **Case notes—retrolental fibroplasia.** Brit. J. Ophth. **36**:691-693, Dec., 1952.

The pathologic report of an observed case of retrolental fibroplasia is presented. Fibrovascular proliferation and blood vessels passing from the inner retinal layer to the vitreous were observed. No evidence of general vascular disease, nevus formation or cerebral malformation were present. Orwyn H. Ellis.

Beretta, Francesco. **Glioma of the retina in a subject aged 48 years.** Ann. di ottal. e clin. ocul. **79**:337-342, June, 1953.

A glioma of the retina was found in an eye enucleated for absolute glaucoma in a man aged 48. The possible causes for slowing down, arresting, or, exceptionally, healing of such a tumor are discussed. (3 figures, 12 references) John J. Stern.

Bruna, F. **Recurrences and severe course in chorioretinitis juxtapapillaris.** Boll. d'ocul. **32**:424-443, July, 1953.

Three patients, aged 35, 45, and 50 years, with severe Jensen's chorioretinitis of long duration and with recurrences are described extensively; in one of the eyes anterior uveitis and consecutive cataract ensued. The author assumes that the lesion was tuberculous. (3 figures, 49 references) K. W. Ascher.

Cagianut, B., and Hoffmann-Egg, L. **Changes of the fundus in macroglobulinemias.** Arch. f. Ophth. **153**:391-406, 1953.

Macroglobulinemias exist where an increase of the various fractions of serum globulin are found with molecular weights up to 200,000. They are most often due to reactive, storage, or neoplastic reticulohistiocytoses. Vitreous opacities, multiple

retinal hemorrhages and detachment due to subretinal exudations occur and might be diagnostically helpful.

Ernst Schmerl.

Chinaglia, V. **Persistence of Cloquet's canal (case report).** Ann. di ottal. e clin. ocul., **79**:283-296, May, 1953.

Persistence of Cloquet's canal was seen in a boy, 14 years of age, without any other malformations. The literature (most of it between 1850 and 1910) is discussed. (4 figures, 42 references)

John J. Stern.

Del Rio Cabanas, J. L., and Albanaz Gallan, J. L. **The effect of arteriosclerosis and senile hypertension on the ocular fundus and the kidneys.** Arch. Soc. oftal. hispano-am., **13**:504-523, May, 1953.

The material for this study consists of 100 inmates, of both sexes, between 71 and 109 years old, of an old people's home in Madrid. Age, sex, blood pressure, specific gravity of urine, and fundus picture are tabulated. In 28 cases there were such hypertensive changes in the fundus, as retinal angiopathy, hypertensive retinopathy, and hypertensive neuroretinopathy. Forty-three patients had senile changes, such as diffuse choroidal sclerosis, chorioretinal sclerosis, chorioretinal atrophic foci, senile macular degeneration, drusen and filiform retinal arteries. Six patients had normal findings. The authors prefer the classification of hypertensive retinopathy proposed by Puig Solanes to that of Wagener and Keith. The blood pressure was found higher in the hypertensive than in the arteriosclerotic patients. Twenty-eight percent of the cases with hypertensive retinopathy were encountered in patients who were apparently in good health and in whom fundus changes would not be suspected. Inadequacy of renal function based on the specific gravity test was found in all cases. The blood urea was normal in all cases. (20 references)

Kay K. Daily.

Dorello, Ugo. **Treatment of central vein thrombosis with ethylic ester of acetic acid (Tromexan).** Rassegna ital. d'ottal. **22**:286-304, May-June, 1953.

Seven cases of thrombosis of the central vein or its branches, dating from a few days to eight months, were treated with Tromexan (Geigy). Six of the patients showed undoubted improvement in vision, in fields and ophthalmoscopically. Dorello feels that if a larger number of cases show similar improvement Tromexan will prove to be the best treatment known for thrombosis of the retinal vein. (6 figures, 23 references)

Eugene M. Blake.

Frazakas, A., and Szauter, A. **The diagnostic significance of perivascular connective tissue in the fundus.** Ophthalmologica **124**:303-308, Nov., 1952.

The authors have made a systematic ophthalmoscopic study of noncongenital connective tissue formations on the disc and have found them to be particularly common in epilepsy. These formations may represent a manifestation or associated symptom of cerebral gliosis.

Peter C. Kronfeld.

François, J., and Deweer, J. P. **A case of tuberous sclerosis (Bourneville).** Ophthalmologica **124**:321-339, Dec., 1952.

A typical, thoroughly studied case of tuberous sclerosis is reported in detail. The outstanding manifestations of the disease were epileptic fits, moderate mental deficiency, sebaceous adenomas, areas of intracerebral calcification and typical retinal lesions. Heredity of the dominant type was evident. The results of electroencephalography were particularly interesting and revealing. (14 figures, extensive bibliography covering the last 13 years)

Peter C. Kronfeld.

# NEWS ITEMS

Edited by Donald J. Lyle, M.D.
601 Union Trust Building, Cincinnati 2

News items should reach the editor by the 12th of the month but, to receive adequate publicity, notices of postgraduate courses, meetings, and so forth should be received at least three months before the date of occurrence.

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## Deaths

Dr. James Clyde Markel, Pittsburgh, Pennsylvania, died October 1, 1953, aged 75 years.

## Announcements

### Pittsburgh lectures

Special lectures in the basic science of ophthalmology will be given in evening sessions throughout the school term of the University of Pittsburgh School of Medicine by the staff of the Eye, Ear, Nose, and Throat Hospital. These lectures are free to physicians. The schedule may be obtained from Dr. Murray F. McCaslin, chief, eye service, Eye, Ear, Nose, and Throat Hospital.

### Research fellowship

Information regarding a Research Fellowship in Ophthalmology at Indiana University Medical Center may be obtained by writing to Dr. T. F. Schlaegel, Jr., 1100 West Michigan Street, Indianapolis 7, Indiana. It is not necessary to have had training in ophthalmology to be accepted for this position. For those who have not had a graduate course in ophthalmology, the fellowship will provide some training prior to a residency. Fellows assist in the eye clinic and at eye surgery and attend the formal classes for eye residents. The stipend is $150 per month plus room and laundry.

### Wayne University postgraduate course

The Department of Ophthalmology of Wayne University College of Medicine will give nine months' postgraduate training in basic ophthalmology beginning September 13, 1954.

Six mornings a week are spent in lectures and laboratories. Each afternoon students are assigned to eye clinics of affiliated hospitals. A fundus clinic is held weekly; also, one on muscles.

Students are given 120 hours of training in physiologic optics, 122 hours in histology and pathology, 60 hours in biochemistry, 40 hours in neuroanatomy, and so forth.

Tuition is $900. Brochures on the basic science course will be mailed upon request. For further information write to Dr. A. D. Ruedemann, Chairman, Department of Ophthalmology, 690 Mullett Street, Detroit 26, Michigan.

### XIX Congress of Oto-Neuro-Ophthalmology

The XIX International Congress of Oto-Neuro-Ophthalmology will be held from June 11 to 17, 1954, in São Paulo, Brazil. The officers of the congress are:

Honorary presidents: Prof. Aderbal Tolosa, Prof. A. Paula Santos, Dr. J. Penido Burnier, Dr. J. Pereira Gomes, Prof. Moacyr E. Alvaro, Prof. Paulino Longo, and Prof. A. Mangabeir Albernaz; president: Prof. Cyro de Rezende; vice-president: Dr. Rafael da Nova; general secretary: Dr. Luiz Piza Neto.

Secretaries: Dr. Aloysio Mattos Pimenta, Dr. Antonio Vicente de Azevedo, Dr. Paulo Braga de Magalhães, Dr. Roberto Melaragno, and Dr. Rubens Belfort Mattos; treasurer: Dr. Sylvio Almeida Toledo.

The official themes are.

1. Metabolic and avitaminotic disturbances in oto-neuro-ophthalmology.
2. The physiopathology of the facial nerve.

These themes are subdivided into various topics, and official speakers from different countries have been invited to prepare special papers. The official languages are: Portuguese, Spanish, English, and French. All physicians who are specialists in oto-rhinolaryngology, neurology, and ophthalmology may apply for membership. Inquiries for information about the congress should be addressed to:

Clinica Oftalmológica, Hospital das Clínicas, São Paulo, Brazil.

### Vienna anniversary celebration

The Vienna Ophthalmological Society will celebrate its 50th anniversary on June 21 and 22, 1954. All ophthalmologists are cordially invited to attend. For further information address:

Dr. Karl Lindner
IX/71, Alserstrasse 4
Vienna, Austria

## Miscellaneous

### New York Course

Under the direction of Dr. Rudolf Aebli, the New York University Post-Graduate Medical School, Department of Ophthalmology, offered a course on "Surgery of the eye," October 26th through 31st.

Speaking on "Local anesthesiology in ophthalmology," was Dr. Walter S. Atkinson, Watertown, New York; on "Cataract surgery," Dr. Aebli; on "Ocular muscle surgery," Dr. Harold Brown.

Dr. Girolamo Bonaccolto spoke on "Corneal transplantation"; Dr. Isadore Givner on "Surgery of primary and secondary glaucoma"; Dr. Brittain F. Payne, "Surgical pathology"; Dr. James W. Smith, "Surgical treatment of retinal detachment"; Dr. Aebli, "Ptosis surgery" and "Plastic surgery."

### American College of Surgeons

At the recent meeting of the American College of Surgeons, panel discusions for ophthalmology included: "Surgery of the eyelids and adnexa," moderator—Dr. Merrill J. Reeh, Portland, Oregon; collaborators—Dr. J. Gordon Cole, New York; Dr. Charles E. Iliff, Baltimore; and Dr. Byron Smith, New York. "Surgical management of glaucoma," moderator—Dr. Samuel J. Meyer, Chicago; collaborators—Dr. A. Gerard DeVoe, New York; Dr. P. Robb McDonald, Philadelphia; Dr. Willis S. Knighton, New York. "Surgical management of cataracts," Moderator—Dr. Erling W. Hansen, Minneapolis; collaborators—Dr. Frederick C. Cordes, San Francisco; Dr. John M. McLean, New York; Dr. Albert D. Ruedemann, Detroit.

### Walter Reed Meeting

A postgraduate course in eye surgery and a symposium on recent advances in ophthalmology was held at the Walter Reed Army Hospital from May 18 to May 23, 1953. The program was arranged and directed by Col. J. H. King, Jr., chief of the Ophthalmology Section and director of the Ocular Research Unit, Walter Reed Army Medical Center. Dr. Adolph Franceschetti, professor De Clinique Ophthalmologique, Geneva, Switzerland, was the guest-of-honor.

The first two days of the meeting were devoted to instruction on indications, techniques, and management of ocular surgery and to practical exercises in animal surgery. This portion of the program was conducted by the staff and consultants of the Ophthalmology Section of Walter Reed Army Hospital and a panel of guest lecturers. One of the high lights of the program was the excellent demonstrations of ocular operations, which were projected by color television from the operating rooms of Walter Reed Army Hospital to a large lecture room where they could be observed by all the participants in the course.

During the second part of the meeting the importance of ophthalmology in the Armed Services was stressed in an introductory talk by Maj. Gen. Leonard D. Heaton (MC), commanding general, Walter Reed Army Medical Center. An interesting discussion of the history of Army ophthalmology, its present status, and its future plans for research and development was presented by Col. J. H. King, Jr. (MC).

Following these talks a review of newer developments in various phases of ophthalmology was presented. The program was as follows:

Dr. Alston Callahan (Birmingham, Alabama), "New concepts in treatment of eye trauma"; Dr. Frank B. Walsh (Baltimore), "Advances in neuro-ophthalmology"; Dr. Michael J. Hogan (San Francisco), "Uveitis: Recent advances in diagnosis and treatment"; Prof. A. Franceschetti (Geneva, Switzerland), "Corneal grafting: Techniques and indications"; Col. Harry L. Berman (MC), and Capt. John D. Morris (MC), "Roentgenology in ophthalmology: 1. Diagnosis; 2. Therapy"; Dr. Irving H. Leopold (Philadelphia), "Modern bacteriology of the eye"; Prof. A. Franceschetti, "Classification and treatment of corneal dystrophies"; Mrs. Helenor Wilder (Washington, D.C.), "Advances in ophthalmic pathology"; Dr. Irving H. Leopold, "Antibiotics in ophthalmology"; Capt. William C. Owens (MC) (Washington, D.C.), "Present status of retrolental fibroplasia"; Dr. Alston Callahan, "Advances in plastic surgery about the eye"; Prof. A. Franceschetti, "Some special indications and techniques in eye surgery"; Dr. Michael J. Hogan, "Macular conditions: Clinical and pathologic correlation."

During his stay, Prof. Franceschetti was the guest-of-honor at a dinner meeting of the Section on Ophthalmology of the Medical Society of the District of Columbia and delivered a talk on "Unusual medications in ocular diseases." He reported on his experience with the retrobulbar use of priscoline, cobra venom, and alcohol, and told of the use of diathermic coagulation in retinal angiomatosis and in prophylaxis for retinal detachments.

On the final day of the meeting, a clinic was held at which cases with diagnostic or therapeutic problems were presented to Prof. Franceschetti by the staff of the Walter Reed Army Hospital. This clinic proved to be one of the interesting and unusual features of the meeting. The symposium was well attended, and attested the interest of the Armed Forces in maintaining sound services for the specialized care required for military personnel today.

## Societies

### Sociedad Venezolana de Oftalmologia

On October 12, 1953, the ophthalmologists of Venezuela founded the Sociedad Venezolana de Oftalmologia. The officers are: President, Dr. Rafael Cordero Moreno; vice-president, Dr. R. Nieves Berti; general secretary, Dr. R. A. Guerrero Pérez; treasurer, Dr. A. Corredor Tancredi; directors, Dr. Gioconda Stopello de Morales Rocha and Dr. Pedro Pablo Morales.

### New York guest speaker

The guest speaker at the November 2, 1953, meeting of the New York Society for Clinical Ophthalmology was Dr. Norman Ashton, director of pathology of the Institute of Ophthalmology, University of London. His paper was entitled "Some anatomic factors in the pathogenesis of ocular disease."

### Reading society meets at Wills Hospital

The 138th meeting of the Reading Eye, Ear, Nose, and Throat Society was held at the Wills Eye Hospital, Philadelphia, Pennsylvania. The program for this all-day meeting was arranged by Dr. Irving H. Leopold, director of research at Wills Hospital. In the morning papers were presented by the workers of the Research Department. Following luncheon, surgery scheduled for the day under the services of the various chiefs of Wills Eye Hospital was observed by the membership which is greatly indebted to Dr. Leopold for arranging such an interesting program.

## Personals

Dr. Isadore Givner, New York, addressed the Detroit Ophthalmological Society on November 19, 1953. The subject of Dr. Givner's paper was "Ocular infections."

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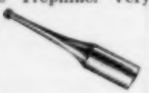

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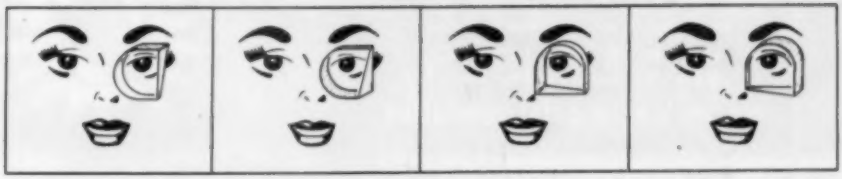

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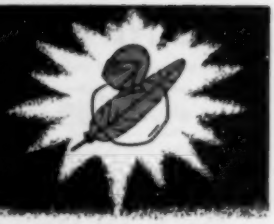

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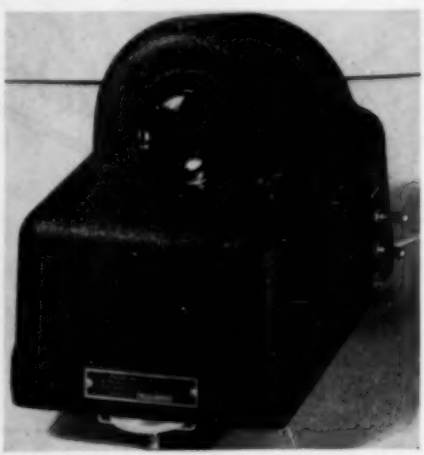

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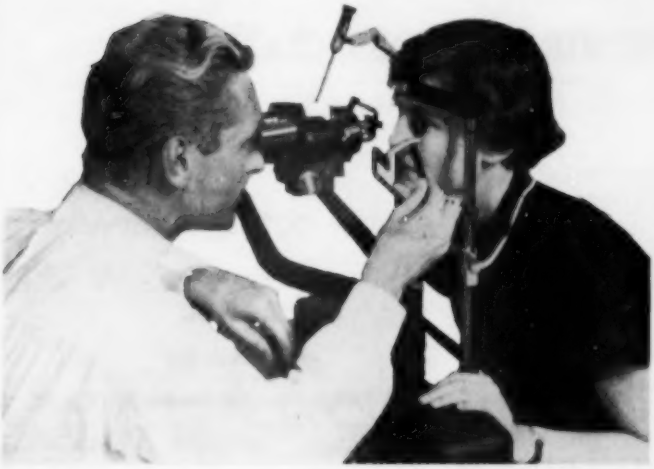

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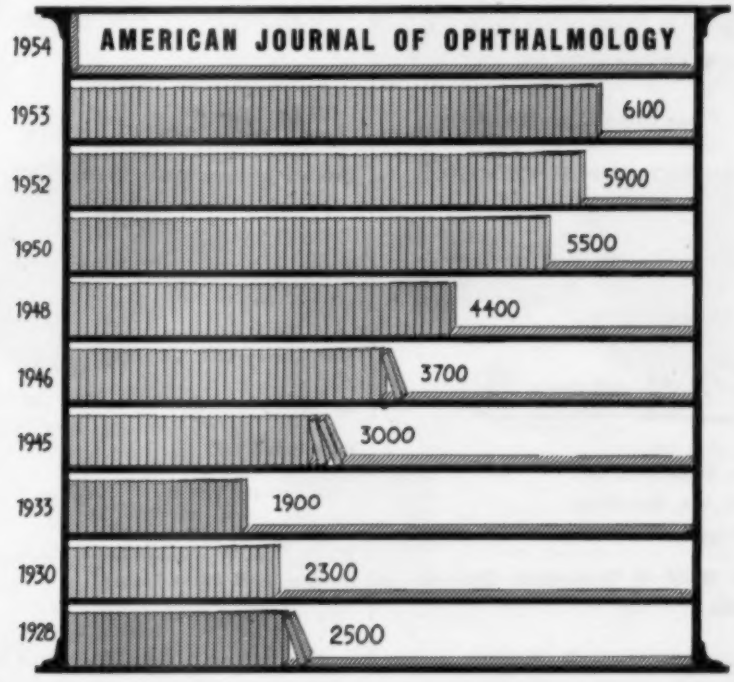

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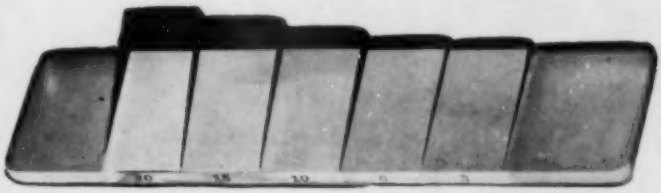

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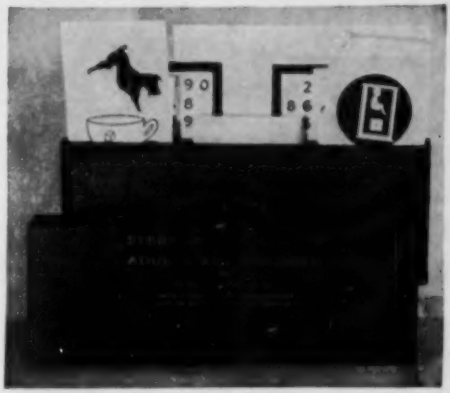

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